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Prof. Henry E. Roscoe,
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20 Nov. 1884.

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OF THE

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ON

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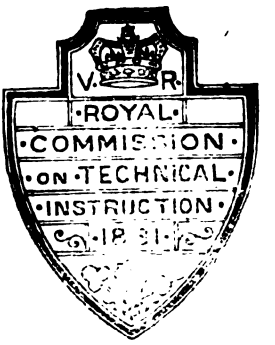

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Note.—Vol. I. contains the general report, Vol. II. the reports of Messrs. Jenkins and Mather, and Vols. III., IV., and V. the Evidence and the remaining Appendices.

COMMISSION TO INQUIRE INTO TECHNICAL INSTRUCTION.

VICTORIA R.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith; To Our Trusty and Well-beloved Bernhard Samuelson, Esquire, Fellow of the Royal Society; Henry Enfield Roscoe, Esquire, Doctor of Laws, Fellow of the Royal Society; Philip Magnus, Esquire, Bachelor of Arts, Bachelor of Science; John Slagg, Esquire; Swire Smith, Esquire; and William Woodall, Esquire, Greeting!

WHEREAS We have deemed it expedient that a Commission should forthwith issue to inquire into the Instruction of the Industrial Classes of certain Foreign Countries in technical and other subjects, for the purpose of comparison with that of the corresponding classes in this Country; and into the influence of such Instruction on manufacturing and other Industries at home and abroad.

NOW KNOW YE, that We, reposing great Trust and Confidence in your knowledge and ability, have authorised and appointed, and do by these Presents authorise and appoint you, the said Bernhard Samuelson, Henry Enfield Roscoe, Philip Magnus, John Slagg, Swire Smith, and William Woodall, to be Our Commissioners for the purposes aforesaid.

And for the better effecting the purposes of this Our Commission, We do by these Presents give and grant unto you, or any three or more of you, in case you shall think fit so to do, full power and authority to call before you such persons as you shall judge likely to afford you any information on the subject of this Our Commission.

And We do by these Presents will and Ordain that this Our Commission shall continue in full force and virtue, and that you, Our said Commissioners, or any three or more of you, may from time to time proceed in the execution thereof, and of every matter and thing therein contained, although the same be not continued from time to time by adjournment.

And We further Ordain that you, or any three or more of you, may have liberty to report your proceedings under this Our Commission, from time to time if you shall judge it expedient so to do.

And Our further Will and Pleasure is that you do, with as little delay as possible, report to Us under your hands and seals, or under the hands and seals of any three or more of you, your opinion upon the several matters herein submitted for your consideration.

And for your assistance in the execution of these Presents We have made choice of Our Trusty and Well-beloved Gilbert Redgrave, Esquire, to be Secretary to this Our Commission.

Given at Our Court at Saint James's, the Twenty-fifth day of August, One thousand eight hundred and eighty-one, in the forty-fifth year of Our reign.

By Her Majesty's Command,
(Signed) W. V. HARCOURT.

ROYAL COMMISSION

ON

TECHNICAL INSTRUCTION.

SECOND REPORT.

MAY IT PLEASE YOUR MAJESTY,

WE, your Commissioners, in the course of our inquiry into the "Instruction of the industrial classes in technical and other subjects," have visited France, Switzerland, Germany, Austria, Belgium, Holland, and Italy, and have examined the schools and educational institutions in Paris, Rheims, Châlons, Amiens, Rouen, Lyons, St. Etienne, Nismes, Toulouse, Limoges, Lille, Roubaix, Croix, Douai, Basle, Winterthur, Zurich, Mulhouse, Guebwiller, Strassburg, Heidelberg, Reutlingen, Stuttgart, Munich, Vienna, Nuremberg, Chemnitz, Freiberg, Dresden, Meissen, Berlin, Düsseldorf, Elberfeld, Gladbach, Remscheid, Barmen, Crefeld, Bochum, Iserlohn, Cologne, Bonn, Höhr Coblentz, Aachen, Sarreguemines, Hanover, Milan, Como, Biella, Turin, Udine, Venice, Brussels, Liege, Maestricht, Verviers, Louvain, Antwerp, Ghent, Rotterdam, The Hague, Delft, and Amsterdam. We also appointed a committee of our members to visit the Black Forest, Thüringen, and the Tyrol, to inquire into the teaching of home industries.

Foreign countries visited.

Visit to Black Forest, &c.

In Great Britain we visited some of the educational establishments of London, Oxford, Cambridge, Manchester, Liverpool, Oldham, Barrow, Birmingham, Leeds, Sheffield, Bradford, Keighley, Saltaire, Macclesfield, Burslem, Nottingham, Bristol, Bedford, Kendal, Edinburgh, and Glasgow. We also visited Ireland and received evidence on the state of elementary education in that country, and on the existing facilities for technical instruction, especially with reference to agriculture, and we inspected educational establishments in Dublin, Belfast, Cork, and other towns.

Places visited in England, Scotland, and Ireland.

Visits to industrial establishments.

Both during our visits to the Continent and in our own country, we availed ourselves of such opportunities as presented themselves of inspecting industrial works and of conversing with the leading manufacturers respecting the educational facilities afforded to them and to their workpeople, and of inquiring into the influence of education upon the development of manufactures.

Special Report on Technical Instruction as affecting Agriculture, by Mr. H. M. Jenkins.

In our inquiry into agricultural education, we secured the services of Mr. H. M. Jenkins, the Secretary of the Royal Agricultural Society of England, as a sub-commissioner, and instructed him to furnish us with a report on the teaching of agriculture in France, Germany, Denmark, Holland, and the United Kingdom.

Special report on the United States of America.

Information of great value on the condition of general and technical education, and on the industries of the United States, also on primary education in Canada, has been kindly furnished to us in a report by Mr. William Mather, Mechanical Engineer of Salford, who visited those countries for the purpose of making the inquiry. Your Commissioners also obtained information on the same subject from several American gentlemen of eminence during their visits to Europe.

Evidence taken.

Besides the conversations already mentioned, we also took more formal evidence in this country and on the Continent from persons qualified to give us information on the subject of primary, technical, scientific, and artistic education, and on manufactures and commerce as affected by education.

This evidence is supplemented by written statements furnished by various Government officers, by organizations of working men, and by other persons whose opinions we considered to be of value.

Inquiry includes schools of all classes.

Inasmuch as the general education of the various countries has important bearings upon technical instruction, and also directly upon industry, it became necessary for us to take it into account. Accordingly in the First Part of our general Report contained in this volume we give, by way of introduction to its main subject (the account of foreign technical schools), a brief outline of the general education in each country, available for workpeople, foremen and proprietors and managers of industrial works.

First Part. Introduction on general education abroad.

Foreign technical schools.

This part of the Report next proceeds to give an account of visits paid to special trade and technical schools on the Continent, which have for their object the training of the various classes engaged in industrial pursuits.

Similar schools kept under the same heading.

With a view of comparing similar schools in different countries we have, as far as possible, arranged institutions of the same type, and having similar objects, in distinct groups:—Thus, general technical schools, industrial-art schools, weaving schools, and Polytechnic Schools, are dealt with in separate groups. This part of the Report also contains a brief account of some typical industrial museums.

Second part

The Second Part of our Report contains notices of visits to important manufacturing establishments abroad, and treats of

the influence which technical schools have exerted upon the industries which they are designed to promote. It includes accounts of industrial societies established by manufacturers and others on the continent for the development of their industries, for the improvement of the workpeople by means of education, and for various social objects. manufacturing establishments.

In the two foregoing portions of the Report will also be found the opinions given to us on various points connected with technical instruction by experienced persons. Opinions of competent Foreign authorities.

The Third Part contains descriptions of our visits to various educational and other establishments in the United Kingdom, and, more especially, information on technical instruction at home. Third part refers to technical education in England.

The Fourth and last Part contains the Conclusions at which we have arrived on the subject referred to us by Your Majesty, and the Recommendations with respect thereto, which we feel justified in making. Fourth part contains conclusions and recommendations.

Our General Report is contained in Volume I. Volume II. contains the Report of Mr. Jenkins on Agricultural Education, and Mr. Mather's account of his visit to America. A valuable Report by Mr. Thos. Wardle on the Silk Industry, and Prof. Sullivan's Scheme of Technical Education for Ireland, together with the Evidence and the various Appendices, with the exception of the Report of our visit to the Black Forest, the Tyrol, and Thüringen (which we have placed in Vol. I.) will be found in Volumes III., IV. and V. The Appendices consist of written statements from various parties relating to our Inquiry, of programmes of schools, General Statistics, &c. Arrangement of the different volumes.

PART I.

PART I.

ON TECHNICAL INSTRUCTION ABROAD, WITH INTRODUCTORY REMARKS ON PRIMARY AND SECONDARY SCHOOLS.

General scheme of education in each country.

As an introduction to our Report on Technical Instruction abroad, we have brought together a few of the principal facts relating to the general scheme of education in each of the different countries we have visited. It is necessary, in order to understand the position of the purely technical schools, of which we shall have to treat subsequently, that an outline should be given of the system that has been adopted for the general education of young people of both sexes, from the commencement of the school age onwards, and it is also expedient for another reason, viz., that in the case of the working population of some countries, the elementary instruction which they receive is their *only* educational training.

(1.) FRANCE.

Primary education in France.

We gave an account of the primary instruction of France in our First Report, and we have only to add to it that, as we anticipated, attendance at school has since been made compulsory; that gratuitous higher elementary, which includes technical, instruction, is being extended in many of the large towns, and that the sums devoted in the State and Communal Budgets to the creation and maintenance of schools have increased enormously. Instruction in the use of tools is now very general in the primary schools of Paris.

Secondary schools.

The secondary schools of France, the Lycées and Colleges, some of which we visited, have been so often described, and in order to do justice to the subject, would require to be treated of at such length by us, that we merely name them as being the schools which prepare the students for the higher technical institutions, such as the École Polytechnique, and the École Centrale des Arts et Manufactures, which we describe in the following pages. The instruction given in the secondary schools is almost invariably on the old classical lines, the only departure being that in some of the Lycées additional time is given to mathematics, in the last two years, by boys who intend to enter the higher technical schools.

Higher elementary schools.

A relatively small number of youths are also prepared for these latter in schools of the highest type of so-called higher elementary, but really secondary schools, like the École Chaptal. In these, considerable time is given to the physical sciences, especially to chemistry, and some of them are furnished with

excellent laboratories. Speaking generally, we are of opinion that the ordinary schools of France excel ours as a preparation for the technical school:—

(1.) As to the primary schools, in the greater attention given both to geometrical and freehand drawing, the latter almost entirely from models, to the excellent provision of these models, and, in so far as it has gone, in teaching the use of tools; and

(2.) As to the secondary schools, in giving more time to mathematics, especially in the upper classes of the Lycées.

(2.) SWITZERLAND.

Zurich as a type of Switzerland.

The division of Switzerland into cantons, each of which has its own laws and administration, renders any general description of the scheme of instruction for the whole country impossible, and we therefore selected the canton of Zurich, which has long been regarded as the foremost in matters of education, and devoted special attention to its schools of all classes, more particularly in the town of Zurich, though we likewise visited Winterthur, situated in the same canton.

ZURICH (TOWN AND CANTON).

Zurich school system.

The elementary and secondary* education here, as in all other parts of Switzerland, is gratuitous, and as to elementary instruction, compulsory. The system of instruction embraces the following schools:—

A. Primary schools.
B. Secondary „
C. Evening „
D. High „

Primary education.

All children between 6† and 14 years of age must attend school, and must remain in the primary school until the age of 12.

On leaving the primary school at the age of 12, the children can either attend the secondary school, or they may, subject to the prescribed attendance at a supplementary school, enter into practical life. The school course in secondary schools extends over four years, and those entering such schools and remaining in them for two years (until 14 years old) are absolved from further school attendance.

Ergaenzungs-schulen.

Those who do not enter the secondary school are obliged to attend for four years at a supplementary school (Ergaenzungs-schule). This school is held on two half-days a week, and its

* The Secundarschulen of Switzerland correspond most nearly very our higher elementary or "graded" schools.

† From 4 to 5 years of age the Swiss children usually attend the Kindergarten schools, conducted according to the system of Froebel. The attendance at these schools is optional, and they have no State endowment.

chief aim is to enable the scholars to retain what they have learnt in the primary schools, and, if possible, to develope it somewhat further. Although primary instruction in private establishments is permitted, about 97·5 per cent. of the children of all classes attend the public primary schools.

Proposed change.

The above plan of supplementary schools is, however, found to be unsatisfactory, and a law is about to be passed extending the compulsory attendance at the ordinary elementary school up to the age of 14. Even now no child is allowed to enter a factory until the completion of the 14th year.

Zurich elementary school.

One of the best elementary Swiss schools visited by the Commissioners is that on the Lindescher Platz in Zurich. The cost of building this school was 43,000*l.*, which amounts to 66*l.* per head. Irregularity of attendance is practically unknown; all the children learn one foreign language; moreover they are all taught drawing, and have object lessons in natural history. In the higher classes they are instructed in the rudiments of chemistry and physics, great pains being taken to place before the children well-arranged specimens, which are contained in a school museum. These museums form very noteworthy features of the Zurich schools. Among the objects we found there were simple chemical and physical apparatus, chemical specimens, geographical relief-maps, showing the Alps and their glaciers, typical collections of commonly occurring and useful rocks and minerals, excellent botanical models, as well as collections of insects carefully labelled, a complete herbarium, zoological and anatomical specimens and models; the collection, in fact, serving as a type of what such a school museum should be. Many of the specimens were collected and arranged by the teachers.

School museum.

All the school subjects were taught intelligently and well; we were specially struck with the clean and tidy appearance of the boys, and there was a difficulty in realising that the school consisted mainly of children of the lower classes of the population.

Higher schools of Zurich. The Gymnasium and Industrie Schule.

The higher schools for boys in the Canton of Zurich consist of the Gymnasium or classical school, preparing for the University or the Polytechnic, and the Trade School (Industrieschule), which prepares for the Polytechnic, or for direct entrance into trade; both of these former schools being included under the term Cantonal School (Canton Schule).

Gymnasium.

The Gymnasium is entered at 12 years of age, after an examination, and consists of six classes, corresponding to one year each, so that the pupils leaving at 18 or 19, would pass from the 6th class with the leaving "certificate," enabling them to enter any university or polytechnic school without an entrance examination.

Industrieschule.

The Industrieschule is entered at the age of 14, and consists of four classes extending over 3½ years, the first class being a preparatory one. From the second class onwards the school separates into two divisions:—

(*a.*) A technical section;
(*b.*) A commercial „ ;

the former again dividing in the 3rd and 4th years into a mathematical and a natural science section. The commercial section ends with the third year.

Cantonal School.

We visited the Cantonal School of the town of Zurich, consisting of a Gymnasium and an Industrieschule under the same roof. It contains about 500 pupils and 44 teachers. The class-rooms are exceedingly large and airy, each fitted with desks for about 40 students, but capable of accommodating many more. In the Industrie school there is a well-arranged chemical laboratory in which the students have six hours' practical work per week in the preparation of simple chemical compounds. There is a good collection of physical apparatus, common to the two schools. The lectures on physics are abundantly illustrated by excellent experiments, but the pupils themselves do no practical work in this subject. The teaching of the highest class is in advance of that usually found in similar schools in England. In connection with the physical collections was a small workshop containing a water-motor for working the dynamo, and used for the repair of apparatus, &c., but only by the teacher and his assistants. Drawing forms an important feature of the instruction in this school, an average of six hours per week being devoted to this subject. In Appendix No. 2. Vol. V. is the programme of instruction in the two schools, (*a.*) Gymnasium, and (*b.*) Industrieschule. The influence of such schools on the industrial condition of Switzerland is very conspicuous.

The secondary schools for girls are analogous to the Industrieschulen for boys. One of these well-conducted institutions was visited by us. It is attended by girls between the ages of 12 and 16, of all classes, irrespective of social position. The class-rooms are all large, and remarkably well furnished, as is the case in the boys' school previously described. With the exception of needlework and English, all the subjects were taught by male teachers. Among the remarkable features of this school was the excellent museum.

A school has been established for the higher training of girls, for which these secondary schools prepare them.

It will be seen from the budget of the Canton of Zurich, in Appendix 3, Vol. V., that the Educational Vote absorbs nearly one third of the total expenses of the Canton.

(3.) GERMANY.

Germany. Primary or Volksschulen.

Although the system of education is not exactly the same in all parts of Germany, there are certain general features which are common to the different States. As in Switzerland, education is compulsory, and with the exception of those children who are preparing for the higher secondary schools, all classes of the population are educated in the public elementary schools or "Volksschulen." The children enter the primary schools at the age of six, and remain until the age of 14. Most of those, however, who intend to pursue their education in secondary

GERMANY.

schools enter a preparatory school in place of an elementary school, and generally leave that school at the age of nine or ten.

Secondary schools.

In nearly all parts of Germany the secondary schools consist of higher elementary and secondary schools proper. In North Germany generally there are three kinds of secondary schools; the Gymnasium or classical school, the Real Gymnasium in which Latin is taught, but not Greek, additional time being given to Science and Mathematics, and the Ober Real school in which a still greater amount of attention is devoted to drawing and science, but in which neither Latin nor Greek is taught, the modern languages being substituted. The complete course of instruction in any one of these schools occupies 10 years. Pupils from the Gymnasium, who have obtained the leaving certificate, are entitled to enter any of the faculties of the University or the Polytechnic School. Those leaving the Real Gymnasium with a certificate can only enter the Polytechnic School and the philosophical faculty of the University, whilst those leaving the Ober Real school are only qualified for entrance into the Polytechnic School. In Bavaria the Real school, in which Latin is not taught, is of a lower grade than the Real school above referred to, and corresponds more nearly with what is generally known as the higher elementary school. Pupils are received into this class of school from the elementary schools at the age of 12, and the course lasts four years. Similar schools are found in North Germany under various designations; they were formerly called Gewerbe schools, but are now more generally classified as Unter-Real schools.

Science instruction.

Although modern languages, mathematics, and science form the main subjects of instruction in the higher Real schools of North Germany, very few of these schools are fitted with laboratories. n which the pupils have an opportunity of studying science practically, whereas in the lower grade Real schools of Bavaria (an excellent example of which was visited by your Commissioners in Munich) laboratory instruction forms an important feature of the education. The curriculum of each of these types of schools will be found in the Appendix, by reference to which it will be seen that the hours of instruction vary from 30 to 36 per week.*

Schools all supported by public funds.

The secondary as well as the elementary schools of Germany are under State supervision, and the system of instruction is practically the same in all schools of the same grade in the same State. The primary schools are supported entirely by the Commune or municipality in which they are situated, except in the case of the very poorest Communes which receive some assistance from the State or province. With regard to the cost of maintenance of the secondary schools there is no fixed rule, but

* An idea of the co-relation of the educational establishments in Bavaria from the primary school up to the Polytechnic and University is clearly shown in the Diagram, Appendix 4, Vol. V., prepared for the Commission by Director von Bauernfeind of the Munich Polytechnic School.

most of them are supported by the Communes. In some cases the Communes furnish the buildings, and the current expenses are defrayed wholly or partly by the State; in others a portion of the cost is borne by the province; some few, however, are supported wholly or partly from ancient endowments. In many of the large cities, primary education is entirely gratuitious, in nearly all primary schools the fees are extremely low, and the children of necessitous parents can in all cases obtain free instruction. The fees in the secondary schools likewise are extremely low.

Extent of secondary education in Germany.

These schools, unlike most of those in our own country, are, with scarcely any exception, day schools, and it may be said that throughout Germany secondary private adventure schools for German boys are practically unknown.* It follows that secondary instruction of a superior and systematic kind is placed within the reach of the children of parents of limited means, to an extent of which we can form no conception in this country.

Continuation schools.

In some States, as for instance in Saxony, children who have not made satisfactory progress in the elementary school at the age of 14, when they have to go to work, are obliged to attend a continuation school, held in the evenings and on Sundays, for two years longer. The instruction in these schools is simply elementary, with the addition of such subjects as book-keeping, rudimentary mathematics, &c. There are similar schools in other parts of Germany at which the attendance is not compulsory. To give an idea of the German School system, we have selected the statistics relating to Saxony, which will be found in Appendix 5, Vol. V.

(4.) AUSTRIA.

Public elementary schools.

The public elementary schools of Austria may be divided into two classes, the primary schools (elementary and advanced), and the burgher schools. With these are included also all the infant schools, orphan and convent schools, special schools for the blind, deaf and dumb, and seminaries for teachers.

Middle schools.

The middle schools, as in Germany, comprise the Real Schools, Real Gymnasia, and Gymnasia proper.

High schools.

The high schools include the Universities and Polytechnic Schools.

Infant schools.

Infant schools exist in all the principal towns, and are supported partly by the communes, partly by private associations and societies, by manufacturers, and proprietors of industrial establishments. They are under State supervision, though they do not receive Government grants.

* There are, as is well known, many private adventure secondary schools for foreigners.

Grades.

The primary schools receive children from the 6th to the 15th year of their age; they may be either public or private, the former being the State schools, the latter due to private enterprise. The primary schools are of two grades: lower elementary schools, with three classes, chiefly in villages; higher elementary schools, with four classes. The burgher schools have six or seven classes. The lower elementary instruction is compulsory, but compulsion does not exist except as hereafter stated with respect to attendance at the higher elementary and higher schools.

Continuation schools.

Every higher elementary school has connected with it a continuation school at which attendance is compulsory for those children who do not attend a school of higher grade, from the time they leave the primary school, until they attain the age of 15. Poor children have their school fees remitted. For those who can pay, the fees vary from 1*s.* 8*d.* to 6*s.* 8*d.* per annum.

The Continuation schools are maintained partly by the State, partly by the Commune. The Government supports also a number of higher elementary and burgher schools and all the schools for the blind, deaf and dumb. It has under its charge the seminaries for teachers, and bears the expense of numerous technical, or trade schools. The children who intend to carry their education further, leave the primary school at 12, and enter the fourth class of the higher elementary school from which they may pass to the Gymnasium, the Real school, or one of the special schools of a professional character.

Intermediate schools.

The secondary schools of Austria are similar to those of Germany, and call for no special description. We learned that the Real Gymnasium in which Latin is taught but not Greek, as a type of school, is not considered satisfactory, neither affording the best preparation for the Polytechnic nor for the University. Some of the schools of Vienna visited by the Commission were carried on in magnificent and well-appointed buildings, with excellent teaching apparatus, and well-equipped laboratories. The Gymnasia are either public or private institutions, the Real schools are often partly supported by the State, and partly by the Commune.

(5.) Belgium.

Primary education.

Primary instruction.—Attendance at school is not compulsory in Belgium, but in each Commune there must be at least one public (government) school. Parents can demand gratuitous instruction, and some communes make their schools free to all. There is great opposition on the part of the clergy to the government schools, and they endeavour to dissuade the parents from sending their children to these schools. It is stated on authority that about 60 per cent. of the children of school age (6–14) in Belgium are in the government schools, about 25 per cent. in clerical or private schools, and 15 per cent. do not attend school

at all. These statistics are however, not admitted by the clergy, who state that they have 40 per cent. of the children in their schools. The government schools are inspected by government officials, who have no right to enter clerical or private schools. The principle of freedom of instruction is carried so far that it is open to all to establish schools of every type, without control of any kind whatever. Thirty per cent. of the total adult population of Belgium, at the age of conscription can neither read nor write. The percentage varies considerably in different parts; thus in Luxembourg, although the conditions of life are very hard, and many have difficulty in finding a livelihood, the percentage of illiterates is not more than 5; and in the industrial provinces of Liége and Hainault, it is not higher than 12, although children are there employed at an early age in works and mines. In Flanders, on the contrary, the percentage is very high. Statistics of illiterates.

There are no factory laws in Belgium, so that children may be employed at any age, but public opinion has very generally restricted the employment of children to the age of 12, and proprietors of factories frequently establish half-time schools. Women work in the coal pits of the Charleroi district, but in that of Liége only on the bank. Absence of factory laws.

There are evening schools for primary instruction, but their number is decreasing in consequence of the increase in the number of good day schools. Evening classes.

The cost of public primary education is defrayed in about the following proportions:—

By the Commune	-	33 per cent.
„ Province	-	17 „
„ State	-	50 „

Secondary education.—The Government intermediate schools in Belgium consist of two classes. Secondary education.

1. Higher elementary or middle class (moyennes inferieures) schools, the minimum number of which is 100 for boys and 50 for girls as fixed by law of June 15, 1881. The fee is 2*l.* 8*s.* per annum.
2. Secondary schools or Athenées, the minimum number of which as fixed by the same law is 19, and the fee is 4*l.* per annum.

The towns usually give the building, and the State makes up the difference between the fees and cost of tuition.

Many scholarships exist from the primary to the middle class schools, and the latter often have preparatory schools attached. Middle class children usually complete their education in the higher middle school, which is entered at nine, and they leave at 14 to 16 years of age. Scholarships.

The preparation for the Athenée is usually in private schools, or by home teaching. There is an entrance examination; the Preparatory schools.

usual age of admission is 11, and the course is completed at 18. The instruction is divided into two branches: (*a.*) Literary; (*b.*) Scientific or professional; in each of these there are seven classes. No Latin is taught on the professional side.

Belgian Athenées.

The government Athenées are day schools, but boarding houses are attached to them in some large towns. There are 460 students on the professional side, and 440 on the literary side, in the Brussels Athenée. The professors are paid fixed salaries, the highest being 280*l.* per annum.

Clergy schools.

Parallel with the government education in secondary as in primary schools, are the schools of the clergy. These are more numerous than the government schools. For example, there are in Brussels two clerical Athenées, St. Louis and St. Michel, each with 1,200 pupils. It is generally stated as to education given in the two sets of schools, that for classics and modern languages the government schools are best, whilst for mathematics the clerical instruction is superior. In science both are about on a level. In the clerical Athenées, a much higher salary is paid to the professors than in the State institutions, and consequently some of the best teachers in Belgium are found in the clerical schools.

There are normal government schools, one for classics, at Liége, and one for science, at Ghent.

There is for the government secondary schools one chief inspector, having under him one sub-inspector for classics, one for science, and one for modern languages. The higher technical education in Belgium is carried on in the four Universities. No Polytechnic Schools exist in that country.

(6.) Holland.

Primary education, Holland.

In Holland the law requires that there shall be everywhere sufficient schools to afford primary instruction to all children; any competent person of good moral character may establish, or give instruction in, a primary or secondary school. The communes are responsible for providing an adequate supply of schools for primary instruction, to the maintenance of which the Government is liable to contribute 30 per cent. of the total cost. The public elementary schools are neutral in regard to religious instruction, and grants may be made to private schools on condition of their observing similar neutrality. The elementary schools are divided into ordinary and superior. Attendance at school is not compulsory; one half of all children attending school pay no fees. The total cost of primary instruction in Holland in 1880 was 800,000*l.* for a population of about four millions. Of this cost only about 100,000*l.* was derived from fees. The school attendance in the same year was about 540,000, of whom 400,000 were in public schools. The number of primary school teachers was about 14,000.

There were in Holland in 1880, 156 secondary schools, containing about 15,000 pupils. The greater number of these schools are of the grade of superior intermediate schools, somewhat similar to the German Real-schools; they are non-classical and prepare for trade, for University faculties of Medicine and Philosophy, and also for the only Dutch Polytechnic School at Delft and for higher technical academies. The other secondary schools are 24 Gymnasia and five Pro-Gymnasia, corresponding with schools of a similar kind in Germany. The total cost of education in Holland for 1883 was estimated at 1,250,000*l.*, of which the central government provides 375,000*l.* Secondary education.

(7.) Italy.

Primary education in Italy is free, and compulsory* wherever a sufficient number of efficient schools has been provided.† The children attend one year at the infant school, from which they pass to the elementary school, which, when complete, has four classes, each class representing a year. Primary education Italy.

On leaving the elementary school, the children may either enter the gymnasium (found in cities only) if they are preparing for a classical education, or into the technical school if they are intended for a commercial or industrial career. The gymnasium has five classes; the students of the fifth class may graduate as licentiates and pass to the lyceum, which is a higher school found only in a few of the chief cities. The lyceum has three classes, the highest of which leads to the University. Secondary schools.

The technical schools, which correspond on the industrial side to the Gymnasium on the classical side, have three classes of one year each; their chief object is to prepare for trade, but they are also attended by those are to continue their studies at the Technical Institutes or at the Professional Schools. The Technical Institutes, which we shall describe in their proper place, exist only in the capitals of the provinces. Technical schools.

Besides these schools there are three Higher Technical Institutes, which correspond very nearly with the Polytechnic Schools of Germany.

In addition to the State free schools in Italy, there are many others, among which may be mentioned the Kindergarten schools, some of which are excellent and well conducted. A large number of private schools, both for boys and girls, are under the direction of the clergy.

* It will be seen from our Report on manufactures in the North of Italy, that the law as to compulsion is, in many parts of the country, a dead letter up to the present time.

† Parents, may, however, present a certificate to the syndic or mayor, certifying that they are giving to their children the necessary instruction at their own homes.

SPECIAL TRADE AND TECHNICAL SCHOOLS ABROAD.

Special Technical Schools abroad.

After the preceding brief review of general education on the Continent, we proceed to give a description, as also a comparison, of the schools of the different countries which we visited, for the technical training of the three classes into which we divided the persons engaged in industrial pursuits: namely—the workmen, the foremen, and the masters or managers.

In order to facilitate reference to our descriptions of these various schools, we have arranged them under the following heads, although the classification we have been compelled to adopt is somewhat arbitrary. The various grades of industrial schools have been dealt with as follows:—

I. Evening technical schools available for Artizans, p. 28 to p. 48.

II. Artizans' general technical and apprenticeship schools, p. 48 to p. 69.

III. Intermediate technical schools for foremen and departmental managers, p. 69 to p. 166.

IV. Trade and professional schools for women, p. 166 to 176.

V. Higher technical instruction for employers and managers, p. 176 to p. 216.

In each of these five divisions we have arranged the schools of the different countries in the order observed in our short preliminary review of primary education on the Continent.

I.—EVENING SCHOOLS AVAILABLE FOR ARTIZANS.

Technical education for workmen.

We commence with a description of the special institutions existing in foreign countries for the instruction of apprentices and others during and after the period of their apprenticeship, and for adult workmen, who are occupied during the day time in their ordinary work. These schools must necessarily be either evening or Sunday schools, or, as we shall point out in the cases of industries which can only be practised during certain seasons of the year, schools carried on during certain months only.

Artizans evening schools.

In schools of this kind the instruction consists to a large extent of drawing and modelling, frequently in direct application to special trades, and in some cases supplemented by the execution of practical work in the materials of the trade to which the education refers. In addition to the regular school work, courses of lectures are sometimes given on artistic and scientific subjects, having special relation to various industries, supplemented occasionally by evening class instruction in workshop practice. Such lectures are frequently given under the auspices of the municipal or local authorities, or by the various trade societies of masters, or workmen, or both. Some of these lectures are numerously

attended by workmen and apprentices. The admission is in most cases free, or a nominal fee only is demanded. An account of some of the lectures at which the Commissioners were present will be found in the following pages.

Evening Instruction in France.

Evening instruction in France.

The system of evening instruction is one of the most striking features of the present condition of educational effort in France. The walls of the public buildings of Paris, as well as those of every French town which the Commissioners visited, were largely placarded with the announcements of evening lectures and classes, both for men and women. The subjects of instruction are of the most varied character, including modern languages, social science, physical science, biology, mathematics, applied science, astronomy, &c.

These lectures and classes are carried on at the expense—

(1.) Of the State,
(2.) Of the Municipalities, and
(3.) Of associations or private individuals, or jointly by these bodies.

In Paris itself, under the first head comes the instruction at the Conservatoire and at the École des Beaux Arts; that by the municipality is given in various schools and localities throughout the city.

Nor is this instruction confined to the Government or to non-sectarian bodies, for the Institut Catholique de Paris has established an École Libre, consisting of both day and evening classes in algebra and higher mathematics, physics, mineralogy, geology, and chemistry, including laboratory practice.

Conservatoire National des Arts et Métiers.

The Conservatoire National des Arts et Métiers is the most important institution in France for encouraging scientific tastes amongst the people by popular courses of theoretical and technical science, and also by the well known museum containing models, instruments, &c.

The Commissioners were received on the occasion of their visit by the Sub-Director, M. le Colonel Laussedat. This institution is under the government of the Minister of Agriculture and Commerce, and is especially renowned for its magnificent museum of models and apparatus both of historical interest and of recent date. An important feature of this institution is the *Portefeuille Industriel.* In this Department the registers of all the patents and all the trade-marks in France are kept; and, in addition to this, carefully made drawings of the various patented and other inventions and machines, not patented, are preserved. These drawings are of a most elaborate character, made to scale.

Portefeuille Industriel.

Like all other institutions of the kind in France, the Conservatoire is open gratuitously to the public. The drawings of apparatus, instruments, and machines date from very early times up to the present, and considerable trouble is taken to obtain information

of the newest and best forms of apparatus in the various departments of manufacturing industry. Many of the best and most modern designs inspected by the Commissioners were found to be drawings of English machinery, especially in textile manufactures and engineering work.

Scientific library of the Conservatoire.

Another important department of the Conservatoire is the library of scientific reference, open day and evening gratuitously.

Instruction in the Conservatoire.

The instruction which is given in the Conservatoire is confined to free popular lectures. A large number of distinguished men of science are appointed as professors in the Conservatoire, and deliver popular courses of lectures during the evening. There is, however, no practical laboratory instruction in science.

The following courses were being given at the time of the visit of the Commissioners:—

Applied geometry	M. Laussedat.
Descriptive geometry	M. de la Gournerie.
Applied mechanics	M. Tresca.
Building construction	M. E. Trélat.
Applied physics	M. E. Becquerel.
General chemistry with its application to industry	M. Peligot.
Industrial chemistry	M. Girard.
Applied chemistry	M. de Luynes.
Agricultural and analytical chemistry	M. Boussingault.
Course on agriculture	Professor not named.
Rural economy	M. Mangon.
Spinning and weaving	M. Imbs.
Political economy and industrial legislation	M. Levasseur.
Industrial economy and statistics	M. J. Burat.
Commercial law	M. Malapert.

Lectures on chemistry.

The Commissioners attended one of the evening lectures on chemistry given by M. Peligot in a large theatre, where an audience of from four to five hundred, consisting of all classes, but chiefly of poor persons, was extremely attentive.

M. de Luynes, the professor of technical chemistry, was lecturing on glass manufacture, pottery, and dyeing, and he informed the Commissioners that in his opinion the value of these Conservatoire lectures was considerable, as interesting the masses of the people in scientific subjects. In his lectures he made use as much as possible of practical illustrations. He exhibited the potter's wheel at work, and had glass-blowers from various works to illustrate the mode of blowing glass; for the lectures in dyeing several firms lent workmen to show the practical processes. In the previous year a course of lectures had been given on "wine," beginning with the growth of the grape, treating of the diseases to which it is subject (a matter now naturally exciting much interest in France), the modes of combating the spread of phylloxera, the methods of wine-making, the chemistry of

fermentation, the processes involved in the preparation of various kinds of wine, the modes of testing wine, and, in short, the whole of its chemical history. These lectures were much appreciated, and were attended by wine-dealers and others. This description will serve to furnish a specimen of the kind of instruction which is being given at the Conservatoire.

Public Free Lectures in France.—There are two great societies with complete organizations for elementary instruction, by means of lectures and courses, in Paris and the provinces. The older society was founded in 1830 by ex-pupils of the Polytechnic School. It consisted originally of some 500 members, and took for its motto the device of the school, "*Tout pour la patrie, les sciences et la gloire.*" It was termed the Polytechnic Association. In addition to lectures in nearly every quarter of Paris, given by upwards of 150 professors, courses were delivered in several important provincial towns. Owing to dissensions with respect to the internal administration of its affairs, a large number of the members, chiefly those who had not been trained at the Polytechnic School, left the society in 1848, and founded a similar organization named the Philotechnic Association. Among the subjects included in the course of the Polytechnic Association are arithmetic, geometry, physics, chemistry, machine-construction, drawing of all kinds, bookkeeping, geography, natural history, elementary astronomy, grammar, hygiene and singing. In addition to similar courses the Philotechnic Association provides instruction in English and German. Prizes and certificates are awarded to the students. The lectures are usually given on a Sunday from April to July.*

Other evening instruction in Paris.

Polytechnic and Philotechnic Associations.

Evening Instruction in the Provinces.—As a type of what is being done in the provinces the programme of the *Amiens'*† *Industrial Society* may in the first place be quoted. This society occupies large and convenient new premises in the Rue de Noyon, which were visited by the Commissioners. Day and evening classes are held, both for men and women, on week days and on Sundays. These comprise a variety of subjects, including modern languages, drawing, chemistry applied to dyeing, weaving, &c.

Amiens.

Société Industrielle d'Amiens.

The Industrial Society of Amiens closely resembles the Industrial Society of Mulhouse hereafter referred to,‡ not only giving instruction, but also holding public meetings at which subjects of interest are discussed. Thus, for example, a general monthly meeting was held on the day that the Commissioners were present, at which a paper was read by M. Roger on the application of art to mural decoration, and subsequently a visit was paid by the members of the society to the artist's studio in which this application was illustrated.

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* A full description of the aims and objects of these societies will be found on p. 249 of a Report of the French Minister of Agriculture, Commerce and Public Works, appointed in June, 1863, and translated for the English Government and presented to Parliament, 1869.

† *See* Commissioners' First Report, for Statistics of Population, &c.

‡ *See* Part. II. of Report, p. 349.

Other evening classes in Amiens.

As in other provincial towns in France, evening classes are carried on in Amiens under the Commune. Thus, a notice in the paper of the day stated that on Friday the 25th November the tenth lesson would be given in the communal course on Chemistry by M. Dubois; the programme for that evening being the oxides of nitrogen and nitric acid.

Société Industrielle de Rheims.

The Industrial Society of Rheims is a similar institution providing evening lectures for operatives and artizans. It possesses a good building with well arranged class rooms and lecture theatre. The Commissioners, on the occasion of their visit, found a large class of youths learning English, another class upstairs were attending a lecture on the theory of weaving; in the drawing school two classes were engaged, the one learning freehand drawing from copies and casts, the other geometry, projection, and mechanical and architectural drawing. The classes were well attended, and from the printed list handed in, it appears that there are no less than fourteen subjects taught. In addition to these courses, free public lectures on chemistry and physics are given by M. Leblanc, under the auspices of the Municipal Council, three times a week during the winter in the large lecture theatre of the Professional School. *See* p. 75.

Lyons Sunday lectures.

At Lyons the Commissioners attended a lecture on Weaving, one of a course given by M. Loir (the Professor of Weaving in the Commercial School, *see* p. 122) on Sunday mornings in the rooms of the École des Beaux Arts, to workmen and others interested in the subject. The lecture was of an eminently practical character, and about 150 persons were present. The lecturer first described the methods by which the weight of silk in a piece of the woven fabric of given size, can be estimated, and afterwards explained the principle of weaving. This was done by blackboard illustrations, without finished diagrams or models, and was evidently comprehended by the audience, who were familiar with the manufacture. The process of conditioning silk was also fully described. Such lectures are of evident value to the workmen engaged in the trade, giving them a clear conception of the rationale of the various processes.

Société D'Enseignement Professionnel du Rhone. Evening classes, Lyons.

One of the most important series of provincial classes is that conducted in Lyons by the *Société d'Enseignement Professionnel du Rhone*. This society, which was founded in 1864, carried on during the year 1881 no fewer than 131 distinct classes attended by 7,640 students.

The budget of the society for the year 1881 amounted to 3,075*l*. The director of the Society is M. Lang, the energetic head of the École Martinière; the director of studies is M. Girardon, and the honorary president M. Galline, the President of the Chamber of Commerce of Lyons.

Subjects taught.

The classes are held, some in communal schools, and others in special rooms hired by the society. The following gives an idea of the extensive range of the subjects taught: reading and writing, grammar, arithmetic and elementary mathematics, applied mathe-

matics, applied geometry, ornamental design, figure drawing, linear drawing, machine drawing, drawing applied to carpentry, industrial chemistry, elementary mechanics, general physics, applied physics, economic botany, theory of weaving, stone-cutting, book-keeping, commercial law, English, German, Italian, Spanish, history and geography, hygiene, and gymnastics.

One third of the funds for its maintenance is voted in common by the Municipal Council of Lyons, the Council General of the Rhone, and the Chamber of Commerce of Lyons. Other sources of revenue are private donations, annual subscriptions, payments by the pupils, and interest on the reserve fund. The payment by each pupil is three francs for the half year. Funds.

The lectures take place from 8 to 10 in the evening on week days and on Sunday mornings, and there are two or three lessons upon each subject per week; the winter session lasts from October to April. Each course consists of from 50 to 75 lessons, varying from one to two hours in length. If the students desire it, a certain number of these classes are continued during the summer.

Classes for women are held under lady teachers, whilst the classes for botany and hygiene are attended by both men and women. Classes for women.

The Commissioners were informed by M. Lang that the influence of these classes on the people of Lyons had been of a most beneficial character, and that the classes were very popular, as instanced by their rapid growth since their foundation in 1864, the attendance having increased from 1359 in that year to 7,640 in 1881. Opinion of M. Lang.

The society prints each year a programme of the courses, giving a full analysis of the subjects taught, of which the following syllabus of the course of instruction on fuel and the steam engine may serve as an example:— Programme of courses.

Special properties of the different fuels: wood, charcoal, turf, lignite, coal, coke, anthracite coal; Volume of air necessary for combustion; Heat absorbed by smoke; Construction of flues; Furnaces of ordinary construction; Smoke-consuming furnaces; Gas furnaces; Factory chimneys; Production and properties of steam; Comparison of the various forms of boilers; Boiler trials; Comparison of arrangements for ensuring safety of boilers; Incrustation; Expansion; Testing boilers: Theory of the steam engine; High pressure and low pressure, condensing and non-condensing engines; Calculations of the dimensions of an engine; Theory of the parts of an engine: piston, cylinder, valves, &c.; Different kinds of valves; Experiments with brake and indicator; Gas engines.

The Commissioners have not met with any other system of popular science classes so extensive as this, either in France, or in any other of the continental countries which they visited.

Evening Commercial Instruction in Paris.—Besides the technical classes of which we have spoken, there are many other evening schools which are of special importance to those engaged in commercial pursuits. These classes are supported by the munici- Evening commercial classes.

palities, and in Paris they are both numerous and largely attended, being conducted in eight of the communal schools. They are intended for young people who, having finished their primary education, desire to supplement it by acquiring the special knowledge which may be serviceable to them in trade or business. The course is divided into two stages, each of which lasts two years, and amongst the subjects taught, are book-keeping, commercial geography, industrial and commercial technology, civil and commercial law, political economy and modern languages, business correspondence, and commercial composition. Each pupil is expected to devote 12 hours a week to instruction. Certificates are given at the end of the stage on the results of written and oral examinations.

Classes for young women in Paris.

Corresponding courses of instruction exist in Paris for young women, intended to fit them for entrance into business houses. These courses in the preliminary stage occupy ten hours per week, and in the advanced eight hours. They are held in eight communal schools.

Institutions of the same kind exist in many other towns.

Evening Art Classes in France.

Art night schools for artizans. Paris.

We now pass on to the consideration of the French Evening Art Schools for the special instruction of Artizans, commencing with those of Paris. These schools are of the highest possible importance, and exert a great influence on the development of the art industries of France. They are largely subventioned by the Municipality and are all gratuitous. Of the purely Municipal evening art classes, there are no less in the City of Paris than 65, in which a total of 3,334 students are regularly under instruction. 33 of these classes attended by 2,488 students are for ornamental drawing, and 22 classes attended by 846 students, are for geometrical drawing. Five of the former are called "advanced art classes," and in these, instruction is given in drawing from the life, anatomy, and artistic composition. Modelling is taught in almost all the classes. These schools are open on week day evenings from 7 to 9, and on Sunday mornings from 9 to 12. The Commissioners found that in none of these schools was much attention paid to the application of art to industry, the tuition being mainly in pure art.

École des Arts Decoratifs.

The *École Nationale des Arts Decoratifs*, under the direction of M. de Lajolais is one of the most important of the Paris schools available for evening instruction in drawing. It was founded by M. Bachelier in 1765 for the teaching of artizans, and was shortly after taken over by the Government. After several changes of title it received its present name in 1877. At that date, certain courses were opened during the daytime, and since the re-constitution of the school on its present basis in 1880, instruction

is given both in the daytime and during the evening. Some 16 professors share with M. de Lajolais the tuition of the 800 pupils. The instruction is gratuitous and includes mathematics, geometry, architectural construction, freehand drawing and ornament, modelling, drawing from the antique and from life, history of ornament, and decoration. Public lectures on art subjects are given on every Sunday throughout the year.

Budget; number of students.

The budget of the school is 4,236*l.*, towards which the Ministry of Fine Arts contributes 3,796*l.* and the City of Paris 240*l.*, the balance being derived from sundry legacies. There are a considerable number of bursaries. Day scholars, who must be able to read, write, and cypher, are admitted at 10 years of age. Evening students must be not less than 14 years old. During the year 1881–82 the ages of the pupils were as follows:—

Between 10 and 14 years old - -	39
„ 14 „ 20 „ - -	452
„ 20 „ 30 „ - -	281
Above 30 - - - -	27
Total - -	799

System of instruction.

All students before taking their place in any class must prove that they are able to profit by the instruction given therein. The system is one of constant competitions, which take place monthly and quarterly. The boys learn linear drawing, drawing from models, and composition or designing. But though designs are made for decorating all kinds of materials, and for every variety of art manufacture, the question of the possibility of the actual execution of such designs, or of their applicability to the material for which they are intended, does not come into consideration. There is a special atelier for the study of industrial designing under these conditions, and some excellent drawings and models executed by the senior students were shown to us. A small school museum contains examples of some of the best of the works done in the periodical competitions. The reputation of this school under successive teachers has become firmly established, and many of the best artists and designers in France owe to it their early training. The Commissioners are indebted to M. de Lajolais for ample opportunities for examining the work in progress.

Paris municipal school of art.

Another important school is the municipal school, under the care of M. Levasseur, situated at the corner of Rue Ste. Elisabeth, and Rue Turbigo, which has by special decree been constituted one of the new industrial art schools. Here 300 pupils receive instruction every evening throughout the year, except during the busy seasons of the workshops about Christmas when the numbers are somewhat smaller. The director informed us that in this, as in all the other similar schools of design in Paris, drawing is taught from the purely artistic point of view, as this method is thought

to be the only one by which the original power of the pupils can be encouraged and developed. In this particular school about 40 men, consisting of engravers, stuff designers, decorators, &c., were employed in drawing from the nude, whilst 15 were engaged in modelling from the life. In another class, a smaller number of men were occupied in drawing from the antique. The walls were covered with good plaster casts from which another class were modelling in clay. Upstairs there was a large class engaged in mechanical drawng under the charge of a separate professor, and here the pupils have the opportunity, after having passed through the general course of preliminary art instruction, of specialising their drawing according to their various occupations. The pupils were stone-masons, mechanics, joiners, smiths, watch-makers; in short, all the mechanical trades of Paris were represented.

In addition to this, there was a room containing about 100 boys who were employed in elementary drawing from the flat. The spirit of work and attention which animated these students was most remarkable, and any inattention or negligence is punished by expulsion from the school; there being no difficulty in filling up the places, as there are many more desirous of attending than can be accommodated in the rooms.

Municipal drawing schools.

A third type of Paris art schools consists of classes largely carried on in the communal school under the direction of the municipal authorities of the City of Paris. These are simple drawing schools in which the instruction is of a less advanced character than that provided in the special evening schools we have already described. The students attend each evening in the week, but the instruction is only from casts; the collections of casts in the schools visited by the Commissioners were very complete. Of this description of art schools there are as already stated, 65 in Paris.

Jewellers' Art school.

The Commissioners found that the opinions expressed by M. de Lajolais and M. Levasseur as to the inadvisability of giving specialized art instruction was shared by all the other teachers of drawing with whom they had an opportunity of conversing. It was stated, indeed, to one of the Commissioners by Mr. Hervé Mangon that a school of design for special trade purposes would be found in connection with the Syndicate of Jewellery, of which the President is Mr. Ernest Vever, jeweller, of 19, Rue de la Paix. This gentleman, when called upon, expressed his willingness to allow the Commissioners to inspect the school, which is supported by the syndicate at an annual cost of 800*l.* He, however, stated that the system of teaching adopted in the syndical school (which is an evening one) is not different in any way from that generally adopted in all the schools of art in Paris, the apprentices attending the school being instructed in ordinary drawing, and not in special designing for their own trade. He mentioned, however, that the Syndicate had instituted certain annual prizes for designs of articles of jewellery, for competition amongst the apprentices, and that the Syndicate likewise institutes practical examinations in jeweller's work, for which prizes

are given. For this purpose, two consecutive Sundays (from 8 in the morning to 6 in the evening) are set apart, and the material for the manufacture of any given article, say a bracelet, is placed before the candidate. He is then required, by means of the necessary tools, to make up the metal furnished to him into the manufactured article, the design for which is given. The work is finished on the second Sunday, and the prize is awarded by an independent examiner, who has not seen the work carried out, and has no knowledge of the candidates.

Schools for special application of drawing do not exist.

It appears from the Commissioners' inquiries, therefore, that in no school in Paris is drawing at present taught solely in its application to special trades.* It is important, however, to notice that, by decree, dated December 20, 1882, the school of the Rue Ste. Élisabeth, and that of Rue des Petits Hôtels, both of which schools were visited by the Commission, have been reconstituted and created Écoles d'application des Beaux-Arts a l'Industrie, and thus it would appear an attempt is about to be made to give a more technical character to some of the art teaching in Paris.

Provincial Drawing Schools.

Schools of Art of a similar kind to those described for Paris exist in nearly every provincial town in France. The Commissioners visited Art Schools in Lyons, Rheims, Amiens, Toulouse, Lille, Roubaix, and Limoges. Of these the most interesting, perhaps, are those of Lyons, Toulouse, and Limoges.

Lyons Art School.

The *École des Beaux Arts of Lyons* is more essentially a day school than one for evening students. It is situated in excellent buildings in the centre of the town, and though it receives a small annual subsidy from the Ministry of Fine Arts it is in the main a communal institution. Drawing is taught in all its branches, and great attention is paid to designing for various art manufactures. The grant by the City of Lyons for the purpose of this school is 2,280*l.* per annum, and for five municipal drawing schools in various quarters of the town an additional sum of 1,326*l.* was voted during the year of our visit.

École des Beaux Arts at Toulouse.

École des Beaux Arts et des Sciences Industrielles of Toulouse.— This school is well known as being one in which, by its special system of instruction, a knowledge of drawing is very rapidly acquired, and some of the most eminent artists of France owe to it their early training. Among others, M. J. P. Laurens, is a past student of the school. It is absolutely free in all its departments. It receives boys at 10 or 11 years of age. The plan of teaching is as follows:—Classes of seven sit round a black-board on which the monitor makes a sketch, which is copied on slates by the lads forming the class. There is a special class for monitors,—7 or 8 in number. At the time of our visit the boys were drawing geometrical forms on squared slates; from this room they pass onwards into the next class, in which they begin to draw on sugar paper with charcoal. Here they draw solid

* For the opinions of Messrs. Armstrong and Bowler, who were specially deputed to visit and report on the French Schools for the South Kensington Museum, *See* Report XXX. of the Department of Science and Art.

forms (what we should call model drawing), only, in lieu of being freehand work, they are supplied with rulers and encouraged to rule all the straight lines. As the professor told us, the aim in this class is to teach the pupils to gain a correct appreciation of form, and not so much to learn drawing. They begin with squares, cubes, prisms, and solid rectilinear figures, and pass on to spherical forms and architectural details. When proficient in these exercises, they learn copying from the flat, and then pass into the ornament room, where they make careful studies from lithographed copies of ornament, but some go to the model-drawing room and make shaded studies from solids. They can then begin to draw from the cast (ronde bosse), and after a course of fragments, hands, and feet, they begin to draw from the antique. Here the classes are divided, those intending to become painters and those studying as sculptors having each a separate course. The painters draw or paint from the life every day from 8 to 12. The model sits during each hour for three-quarters of an hour and rests a quarter of an hour. There were about 20 pupils in the life class. There is a separate life class for sculptors, sitting on alternate weeks, the pupils working one week in the antique, and one week in the life class. The students have frequent competitions, and an annual competition for three exhibitions of 60*l.* each, to complete their studies in Paris.

Elementary classes meet from 6 to 8 on winter evenings, and from 6 to 8 on summer mornings. These are mainly attended by apprentices, and between 1,000 and 1,100 pupils make use of the classes. There are 25 teachers or assistant teachers, and the salary of a teacher is 48*l.* A good library is attached to the school. Classes in mechanical drawing and projection are largely attended.

Ecole des Beaux Arts, Limoges.

École Municipale des Beaux Arts de Limogès.—This school was established for instruction in art bearing on the ceramic manufactures, for which Limoges has been long famous, and has been recently placed upon an entirely new footing by the decree dated November 5, 1881. It is henceforth to be called *L'École Nationale d'Art Decoratif de Limoges.* The decree lays down the plan of teaching, the staff, the meetings and deliberations of the professors, the juries for the award of prizes, the competitions and exhibitions, the award of "scholarships," the order and discipline, and the punishments to be administered. M. L. de Lajolais the Director of the École Nationale des Arts Décoratifs, at Paris, is also the director of this school.

The Commissioners, on the occasion of their visit, first inspected a ladies' class for painting on china, attended by about 25 students. The students first make a careful study on paper of what they propose to do, this study being either of flowers or foliage from nature, or an arrangement from a copy or engraving; they then paint the design on the plate or vase. They have a small kiln at the school, but it is not used at present; the work being fired at a pottery in the town. Upstairs there was a selection of the works of the pupils laid out for our inspection. These

were drawings from nature, clever studies in water colour from natural foliage (mostly time studies), some good chalk drawings of heads, and from the antique; also crayon drawings from the life. There is a modelling class largely attended, and instruction is given in modelling suited to ceramic work. A class which has produced favourable results is that for the study of etching. The Commissioners were shown some very good etchings produced by students, and some excellent arrangements of flowers and sprays for transfers used for the decoration of china.

One of the difficulties spoken of by M. de Lajolais, as impeding the development of the school, is that the artists trained there have no scope for their abilities in the local factories.

(2.) Evening Instruction in Switzerland.

Evening instruction for artizans in Switzerland.

Continuation schools.

The continuation schools (Ergaenzungsschulen) of Switzerland, which are numerous and important, supplement the teaching of the primary school, and even carry intelligent pupils a few steps onwards and instruct them in the best methods of applying the knowledge gained during childhood to the practical duties of life. In these schools drawing is specially attended to, and in those for girls, needlework. Both sexes also learn singing. The attendance at these schools, or at schools of a somewhat similar rank conducted by local industrial societies, is compulsory for all young persons leaving the primary school at the age of 12 who do not enter a secondary school. As an example of this kind of school, the Commissioners attended at Zurich some of the classes of the local industrial society, (Gewerbe Schulen Verein). The seclasses are numerously frequented by young people of both sexes. They are held in several different localities on week day evenings and Sunday mornings. The following are among the subjects taught:—freehand drawing, four hours per week; linear drawing, three hours; applied drawing for the following trades, each three hours per week, masons, carpenters, joiners, cabinet-makers, mechanics, locksmiths, and whitesmiths; arithmetic, two hours per week; geometry, two hours; writing, four hours; book-keeping for artizans, two hours; mercantile book-keeping, two hours; German language or spelling, two hours; French, three hours; English, two hours; and geometry, two hours per week. The conditions for admission to these classes are that the student must be 16 years of age at least, and must show that he possesses sufficient previous knowledge to profit by the instruction. All fees must be paid in advance, but poor students on making application to the proper authorities can obtain partial or total exemption from payment. The number of students varies from 300 to 650 according to the season, the larger attendance being during the winter months. The fee is from 2 to 4 francs for the entire course, according to the subjects chosen. An exhibition of school work takes place at the termination of each course, twice yearly. Some of the subjects extend over four sessions. The students make an annual summer excursion to some place of interest. The society numbers about 600 members.

(3.) Evening Instruction in Germany.

Evening instruction in Germany.

In forming any estimate of the school system of Germany the Commissioners believe that great importance must be attached to the influence of the evening and Sunday schools, which in many States train large numbers of young persons leaving the primary school at 13, for an additional period of from three to four years. Drawing, together with the ordinary elementary school subjects, is mainly taught, and great care is taken to make the instruction of a kind suitable for the young workman. In South Germany the continuation schools are sometimes simply drawing schools with special application to various handicrafts. In some parts of Germany attendance at these schools is compulsory. In addition to the State schools, there are schools provided by powerful associations of workmen, in which instruction is given on week-day evenings and on Sundays, including literature, drawing, and elementary science. As examples of the latter organisations, we give an outline of the Berlin Artisans' Society (*Handwerker Verein*) and a short account of the German Association for the Diffusion of Popular Education, which has its head-quarters in Berlin, but possesses branches in all parts of Germany.

Berlin Artisans' Society.

The *Berlin Handwerker Verein* was founded in 1859, in order to encourage among its members general culture, sound knowledge of their callings, and good manners (*gute Sitten*). For this purpose lectures, conferences, a library and reading room, classes for the promotion of general and technical instruction, as also for gymnastics and for singing, together with amusements in which all members together with their families can participate, are provided. Any youth may on attaining the age of 17 become a member if he presents testimonials of good character, and is duly introduced by a member. The number of ordinary members was, in 1882, 2,246. During the year 137 lectures were given by 54 lecturers, who are members of the society, on the following subjects:—

Technology, trade, commerce, and political economy	25
Literature and art	21
History and geography	20
Natural history	19
Hygiene	17
Popular education	15
Jurisprudence	11
History of civilisation	9

There are also classes in book-keeping by single and double entry, mercantile arithmetic, English, French, drawing, singing, and shorthand writing. Adults pay 4*d.* per month for instruction, and youths and apprentices 3*d.* The instructors mostly give their services gratuitously.

There are three evenings devoted to declamations, in which regular parts are assumed. Many meetings are set apart for free discussions on social questions. At the close of all lectures the audience are invited to ask questions on any points not clear

to them. Frequently on Saturday evenings there are social gatherings of the members and their families, in which the band and the choir take part.

The public lectures of the Handwerker Verein, are delivered by men of the highest eminence in literature and social science, and form one of the striking features of interest in the Berlin winter season. The addresses of the late Dr. Lasker were attended by all the most remarkable persons of Berlin society. Grants to the society's funds were received from the municipal authorities and from the Education Minister of 50*l.* and 25*l.* respectively. Summer excursions, visits to places of public entertainment at reduced charges, childrens' gatherings, and opportunities for recreation as well as instruction for the members, are largely provided.

Building Trades' School.

There is an important Building Trades' School connected with the society. It is purely a winter school. The instruction commences on 31st October, and ends on the 29th March following. There were in all 79 students who were distributed over the full course of three winter semesters as follows:—40 of the first year, 28 of the second, and 11 of the third year.

To the cost of the Building Trades' School the Minister of Public Instruction contributed 255*l.*, the municipality 125*l.*, and 50*l.* were received from the Weber bequest; the school fees and entrance money amounted to 403*l.*

Among the members of this flourishing society were 148 carpenters, 131 tailors, 95 locksmiths, 82 masons, 75 bookbinders, and 681 commercial and other clerks. The total expenditure for 1881–82 was about 1,500*l.*

Association for the Diffusion of Popular Education.

The *Association for the Diffusion of Popular Education.* The aims of this society are to encourage the discussion of questions relating to free popular education at public meetings conducted by the society, to aid the formation and support of societies having similar aims, to assist in the creation of continuation schools, libraries, reading rooms, &c., to aid in obtaining teachers and in providing lectures; the issue of a journal and of publications bearing on public instruction; the employment of travelling instructors, &c. The report of the society for the year 1882 shows that there were in all 4,749 members, among them being 717 affiliated societies. There were 14 branch societies, and 9 provincial associations in Prussia. Its receipts from subscriptions and donations were 2,044*l.* The branch societies in connection with it appear to do much excellent work: thus, the Frankfort-on-the-Main association states in its eighth report for 1881, that the continuation school for the summer of 1881 had 440 scholars, and for the winter 1881–82, 515 scholars. The classes comprised German, English, French, arithmetic and book-keeping, writing, and drawing, the average attendance at each course being 32. In some subjects owing to the number of pupils there were as many as seven parallel classes. Diplomas were awarded to 15 of the most diligent pupils. The total receipts of the branch were 897*l.*, and 621*l.* were expended on instruction and lectures.

Frankfort branch.

Artizan evening schools in Berlin.

The *Handwerker Schule* of Berlin is an interesting example of a purely technical evening drawing school for artizans, which was visited by the Commissioners who were received by the Director, Dr. Jessen. This is a Government school. The fees are six shillings the half year, for eight hours instruction per week. The school is attended by 470 apprentices and 190 journeymen, who are in all cases recommended and introduced by their employers. In addition, there are special classes for teachers in elementary schools; 70 teachers coming twice a week for instruction from 5 p.m. to 7 p.m.

There are 25 masters employed in this school. The students begin by making outlines from small wooden hand models, a system which has proved very successful in Hamburg under Dr. Jessen, who taught there for over 15 years. In addition to the ordinary teaching of drawing, there is special instruction for each trade by teachers who are practically acquainted with that trade. The instruction is individual, as opposed to class teaching, and nearly all the pupils take up geometrical drawing. Artizans learn projection, from models. After drawing from wooden models they pass on to plaster casts. The complete course consists of three semesters. Tidiness and cleanliness in drawing are accounted of the highest importance. There are in all ten series of classes.

For cabinet-makers, exercises in the preparation of full-sized working drawings are given. They first make a sketch, and then draw the details on a large scale, showing the joints, &c., and so for other trades.

Sunday classes.

Connected with this school are 16 Sunday classes conducted in seven different buildings in the town. There are 12 different trades, each represented by special classes. Thus, for example, there were 100 students in the joiners' class alone.

The budget of the school for evening and Sunday instruction is as follows,—

	£
Students' Fees - -	378
State Subvention - -	1,182
Town „ - -	1,318
Total -	£2,878

Absence of evening science classes in Germany.

Neither in Prussia however, nor in other parts of Germany, have the Commissioners found any system of evening scientific or technical instruction supported by the State or by municipalities to be compared with that existing in France and Belgium, or with that of our own country, though a large number of continuation schools (Fortbildungsschulen) exist in which the ordinary school training is carried on. This absence of evening science classes may partly be acccounted for by the fact that the primary and intermediate education is more advanced than it has been up to the present time in other countries, but the want of this instruction is much felt by the Germans themselves, who contemplate the organisation of a system of technical instruction for artizans, to which a reference will be found in the Appendix.

(4.) Evening Instruction in Austria.

The evening class instruction for artizans in Austria is not as a rule supported, as in France and Belgium, by the Municipalities, but mainly by the trade societies, of which a large number exist. Many of these schools will be reported upon under the heading of "Apprenticeship Schools," whilst here those only will be mentioned in which evening instruction is given. They are founded with a view to provide, for apprentices, instruction in the scientific branches of their different trades. The instruction comprises a course extending over several years. The schools are generally managed by the societies of the masters following each special trade, and in many of these it is stipulated as a condition of apprenticeship that the apprentices should attend the school. Austrian evening schools for artizans.

Amongst the best of these schools are the Jewellers' School and the Turners' School in Vienna; and the Building Trades' School of that city, which will be found described under that section. Guild schools in Vienna.

The Turners' School, or *Fach-Schule für Drechsler-Arbeit*, is essentially a school for apprentices and has 170 pupils who are divided into two sections, the one principally theoretical and the other practical. It is supported mainly by the trade society, which is a very influential one, numbering some 1,500 members who pay 1*s.* 8*d.* per annum for the privilege of membership. The State grants 50*l.* per annum, and there is likewise a yearly subvention from the Chamber of Commerce. For the fitting up of the school, in the first instance, a State grant of 200*l.* was received. Turners' school.

The membership of the Turners' society is compulsory on all master turners, and the apprentices are bound to attend the school. The term of indentures in this trade varies from three to five years, and the school course extends over two years, but it is proposed to add one additional year. The instruction is gratuitous. It is given on Sundays from 8 to 12 a.m, and also on two evenings in the week, Monday and Tuesday, from 6 to 9 p.m. The school budget amounts to 250*l.* The school had been established about eight years at the time of our visit. The students go through a rigidly prescribed course of instruction. It is usual, after leaving the primary school at 13 or 14, to go into practical work for a twelvemonth, in order to obtain some power of practical manipulation, and then to enter these classes. During the first year the pupils learn drawing, arithmetic, elementary physics, book-keeping, and the technology of their trade, raw materials, &c., the teaching being wholly theoretical. In the second year they learn modelling, carving, and all the different kinds of turning. For these purposes the school is provided with a variety of lathes and accommodation for 20 students engaged in practical work at one time. One of the lathes had round it a raised bank of seats, capable of receiving 50 or 60 students to watch the practical demonstrations, and to receive explanations from the master workman. Some excellent specimens of work done Turners' society. Budget of school. Course, first year. Second year.

Value of the school.

in the school were shown to us. The director informed us that it was impossible to estimate the effect of the practical teaching here given upon the trade, as this part of the teaching had only been introduced about two years. The reason assigned for the necessity of this instruction is that in the workshop the pupils are continually occupied with one kind of work, and thus never gain a general knowledge of the entire trade. The turners of Vienna are largely employed in fancy articles, and the tobacco pipe manufacture in meerschaum constitutes a very important industry in the neighbourhood. The school is managed by a committee of employers and officers of the trade society.

Watchmakers' school.

The watchmakers of Vienna have established a similar school.

Jewellers' school.

Fach-Schule for Jewellers and Goldsmiths at Vienna.—This school is in every way similar to the one previously described. It is managed and mainly supported by the Goldsmiths' Trade Society, and is conducted on Sunday mornings and on certain evenings of the week; the use of the rooms being granted free of charge by the municipal authorities. There are 150 students, and the instruction is gratuitous. The school had been open at the time of our visit about three years, and is said to be doing good work. The chief feature of the school is the careful and systematic teaching of drawing. One room fitted up for drawing from models had 56 working places. The copies and examples seemed well chosen as respects their bearing on the distinctive work of the school. There is a special teacher for the metal-chasing department, who showed us some admirable work in silver, brass, &c. Chemistry is taught in its relation to metal working, and there is a furnace with crucibles for practical metallurgy. Valuable prizes are competed for by the students, and the Archduke Carl Ludwig contributes liberally to the prize fund, and takes a great interest in the school. In the class-room for metal-chasing and engraving were shaped working tables precisely similar to those in engravers' shops.

(5.) Evening Class Instruction in Belgium.

Evening art instruction for artizans in Brussels.

In Brussels alone there are four important art schools, the average attendance of students being a little short of 1,200. The largest and most important of these schools is that of the Royal Academy of Fine Arts, which being an art school proper does not belong to this section.

The following are the other schools, which are situated in the various faubourgs—

(1.) Molenbeek-St.-Jean.
(2.) St. Josse-ten-Noode.
(3.) Ixelles.

Molenbeek school.

The *Molenbeek Drawing School* was originally founded in 1865 and is now held in a building erected four years ago by the Commune of Molenbeek in a very poor neighbourhood in the workmen's quarter of the city. The building is large and com-

modious, and contains, in addition to the school of art, a secondary school for girls. There are first-rate class-rooms, and the system of lighting is excellent. There are 300 students, who come every evening in the week, except Sunday, during the winter months. The school was overcrowded, and there were large numbers of boys waiting for admission.

Method of teaching drawing in the Belgian schools.

In this school, as in all the Belgian schools, a system of teaching is prevalent which differs from that adopted in France. This system may be shortly described as follows: The boys begin by drawing geometrical forms with chalk on black-boards which surround the walls of the room. After becoming proficient with the chalk, they pass on to drawing similar forms with charcoal on sugar paper, outline drawing being first practised, and subsequently shading from the cast, and thus in the third year they are led to drawing from the life. This produces great rapidity and boldness of work without aiming at high finish. The quality of drawing seems to be one eminently suited for artizans. Owing to the rapid way in which their work is performed, they acquire sufficient power of drawing for their purposes in a far shorter time than is possible under the school of art system prevalent in England.

Cost of the school building.

An interesting fact connected with the school at Molenbeek is that, although the neighbourhood is extremely poor, no less a sum than 12,000*l.* was raised by the commune for the purpose of building the school, this being the entire cost of the building; an annual grant for maintenance being allowed by the city of Brussels. The total annual expenditure is 1,280*l.*

The St. Josse School.

The *School of St. Josse* has been in operation for 19 years. It contains 400 pupils, and many of them come from the elementary schools, entering at as early an age as eight, and therefore being still occupied during the whole of the day in the elementary school. The teaching does not consist simply of practical work, but lectures are also given on the elements of geometry and the theory of perspective, and these are illustrated by explanations on the black-board which are copied by the class. The best students receive diplomas at the end of the course, which are said to be of considerable value to them in their subsequent career.

Lectures.

Diplomas.

The Ixelles School.

The *School of Ixelles* much resembles those already described. It occupies, jointly with the communal elementary school, a fine building, erected at a cost of 12,000*l.* There are 230 pupils. The annual budget is 680*l.* The students work every evening from 7 to 9, and the advanced classes are taught on Sunday mornings. This school was founded in 1863.

Examinations are held every three months.

At some of these schools, examinations take place every three months in which small prizes are offered, and these appear greatly to stimulate the students in their work. The pupils pay no fees, but, owing to the very small salaries of teachers, the cost of these schools is relatively small. Thus, at the school of St. Josse the payment to the nine teachers amounted to only

160*l.* per annum, the total budget of the school being 760*l.* for the tuition every evening in the week and on Sunday mornings of 400 pupils.

Linear drawing.

Mechanical and architectural drawing are also carefully taught, the students beginning these in the second year, it being a rule that each student must draw well in outline before being permitted to commence drawing with instruments. Special divisions of the school are set apart for constructive drawing for trade purposes. Thus, architects, builders, stonemasons, carpenters, joiners, &c. have special teaching suited to their respective trades, and draw from examples likely to be of service to them in their everyday work. In the third year original designs are carried out by the students, some of which are of a very elaborate character.

The students living in the respective communes obtain instruction gratuitously, but those not resident in the district can only be received on payment of from 18*s.* to 1*l.* 16*s.* per head per annum by the authorities of the communes to which the students belong. The students provide their own materials.

A description of the industrial schools of Belgium, which include both evening and day schools for artizans, will be found on p. 57.

(6.) Evening Instruction in Holland.

Evening art schools in Holland.

The evening art schools for artizans in Holland are generally similar to those in Belgium already described. Such schools are numerous, and of these the Commissioners visited the evening art school at the Hague, of which the director is M. Koelman. It is a day as well as an evening school, and is attended by 330 regular and 100 occasional students.

The Hague.

The school receives an annual subvention of 833*l.* from the the Municipality of the Hague.

School is overcrowded.

The demand for art instruction in the Hague (though not a manufacturing town) appears to be so great that the classes have to be divided. Instruction is given to the juniors and seniors on alternate nights in the week. The classes are held from 7.30 to 9.30 in the evening. In the advanced class attention is paid to the applications of drawing to the special industries on which the pupils are engaged. There are excellent classes for architectural drawing, including details of construction, staircases, windows, &c., and a class for mechanical draughtsmen. In addition to these subjects, classes are also held for instruction in arithmetic, algebra, practical geometry, and projection, and the pupils are required to go through these preliminary subjects before they can pass on to the advanced courses of drawing.

The advanced pupils also attend lectures on the history of ornament, anatomy, perspective, and the history of art.

Fees.

A noteworthy difference, however, between the schools in Holland and those in France and Belgium, is that in the former country the instruction is not gratuitous, each pupil paying eight florins (13*s.* 4*d.*) per semester, it being the opinion of the authorities that the pupils place a greater value on the instruction for which they have to pay.

(7.) Evening Instruction in Italy.

Evening instruction in Italy.

In most of the towns of Italy evening classes are held for workmen, similar to those described as existing in other countries. In Udine, a small manufacturing town of 30,000 inhabitants, evening instruction is given in elementary mathematics, mechanics, and technology, together with drawing and modelling. The courses last four years, and in the third year the drawing lessons are specialised according to the trade of the student. The school has been founded only three years. It is supported from various sources. The Government contributes 120*l.* annually, the town 120*l.*, and the province 20*l.* The Society of Workmen gives 60*l.*, and the Chamber of Commerce 20*l.* At the time of the Commissioners' visit 350 male and 110 female students were inscribed in the school register. The school is open 2½ hours every evening, and 3 hours on Sundays and holidays.

General Review of Continental Evening Schools for Artizans.

General review of evening schools abroad.

In reviewing the schools above described, we are struck by their great variety and by the difference in the nature of the instruction they impart. Foremost in importance may be noted the continuation schools, which exist in nearly all towns of Germany and Switzerland. In Bavaria, Baden, and elsewhere, pupils leaving the primary schools at the age of 13 are compelled to continue their studies in the evening schools till the age of 16, and too much stress cannot be laid upon the value of this regulation.

Continuation schools of Germany.

Influence of these schools on artizans.

These evening schools help to sustain a boy's interest in study at a time when he is likely to forget what he has acquired in the ordinary primary school. For the want of them, apprentices or young workmen frequently find themselves too ignorant to avail themselves of the special technical instruction which they have the opportunities of obtaining; and on this account, and also because they serve to give the youth a taste for study at the time when he begins to appreciate the value of instruction, these schools have proved to be most serviceable to German and Swiss artizans in quickening their intelligence and in affording them useful information bearing upon their trades. At the same time, as primary education advances, and the age at which the children of the working classes leave school is postponed, these continuation schools become less necessary, and technical instruction proper becomes more serviceable.

Evening drawing schools.

Another noteworthy feature in this foreign evening instruction is the very great extension of drawing schools, in which in the same building is taught fine art as well as geometrical and machine drawing, in some instances with special reference to the occupations of the students. As will have been seen, classes in which this instruction is given abound in most of the countries visited by the Commissioners, especially in France, Belgium, and Holland,

and the students in attendance are not only very numerous as compared with the populations of the towns, but they are of all ages, representing all kinds of trades; and, side by side with the workman, is often found a boy of 12 or 13 years of age, who is supplementing in these evening classes the insufficient art instruction which is given at the ordinary primary school.

Evening science classes.

As regards evening science teaching, there seems to be nowhere in Europe any organization for systematic evening instruction comparable, as regards the number of subjects taught and the facilities afforded for the establishment of classes and for the examination of the students' work, with that undertaken by the Science and Art Department in this country, and recently supplemented, in the application of science to special industries, by the City and Guilds of London Institute.

At the same time, it must be borne in mind that in many towns visited by the Commissioners, the evening science teaching was conducted by professors of higher standing than, and of superior scientific attainments to, the ordinary science teachers who conduct courses in some of the largest and most important of the manufacturing centre of this country. In the case of machine construction, the models and materials for instruction were superior to those found in similar schools at home.

Systematic instruction.

Another feature of many of these foreign schools deserves also to be noted, namely that the instruction is systematic, occupying not only several evenings per week, but covering a period of two, three, or even more years.

II. ARTIZANS' GENERAL TECHNICAL SCHOOLS AND APPRENTICESHIP SCHOOLS.

Apprenticeship schools.

The next class of schools to which we have referred in our general classification, are firstly those intended to supersede apprenticeship wholly or partially by a progressive system of workshop instruction in the school itself, these being the true apprenticeship schools, and secondly, trade schools for apprentices and journeymen employed in workshops. In our First Report we dealt with certain schools of this kind existing in France, such as the Communal School of the Boulevard de la Villette, at Paris, and the schools at Havre and other places. We append a short abstract of the accounts therein given of these schools, and would refer to the Report itself for fuller information.

(1.) Apprenticeship Schools in France.

School of the Rue Tournefort.

The School of the Rue Tournefort, Paris.—This school, which will be found more fully described on page 14 of the First Report, is the only primary school in France, so far as the Commissioners are aware, in which rudimentary trade teaching is combined with ordinary elementary instruction. From the ages of 6 to 10 the children have three hourly lessons per week in manual work; boys of 10 and 11 are taught drawing, modelling, carving, joiner's work, and smith's and fitter's work,

whilst in their 12th year of age the instruction is specialized, some taking, as their principal study, modelling and carving, others joiner's work and cabinet making, others again forging and fitting, but all have to devote a certain portion of time each week to the other subjects comprised in the complete course of manual work. The school hours are from eight in the morning to six at night, and in the highest class 18 hours per week are given to manual work.

School of La Villette, Paris.

The School of the Boulevard de la Villette, Paris, is a municipal apprenticeship school for workers in wood and iron, and was established in 1872. The boys are admitted on presentation of the "certificat d'études" of the primary school, or on passing an equivalent examination. The instruction is free, and comprises a general literary and scientific education, in continuation of that of the primary school, and a special technical training. This latter is given by theoretical instruction on the nature of the tools, materials and processes of the workshop, and by practical manual work in the shops. The manual work is divided into two courses; in the first year the pupil spends six hours in the shops daily, and is taught the nature and conversion of materials; in the second and third years he spends respectively six and eight hours per day in the shop, and is engaged in actual construction in connection with the special trade which he adopts. The school hours are from 7 a.m. to 7 p.m. with two hours of interval for meals, recreation, &c. Visits are paid by the students to industrial establishments, and of these, written accounts have to be given. This school will be found more fully described on pp. 17–20 of our First Report.

A large proportion of the boys become engine-fitters or pattern makers, and are said to earn wages varying from 2*s.* 6*d.* to 5*s.* per day on leaving the school.

On the school buildings 49,000*l.* have been expended, and the annual budget amounts to somewhat less than 3,000*l.*; that is rather under 12*l.* per head for the 250 pupils of the school.

Apprenticeship school at Havre.

The Havre Apprenticeship School, which is of the same type as that of the Boulevard de la Villette, will be found more fully described on pp. 21–2 of the First Report. Six hours per day are spent in the shops, during the entire course of three years. The theoretical instruction is of a more elementary character than at the Villette school, and no certificate is required on entrance. The programme of this school is given in Appendix 6, Vol. V.

Watchmakers' school, Paris.

The Watchmakers' School, Paris, situated in the Faubourg du Temple, is the only apprenticeship school proper, founded by the Paris *syndicats* or guilds. Other schools exist under the direction of the various guilds, but these are principally drawing schools in which no special trade instruction is given. The watchmakers' school contains 25 pupils, and the course extends over four years. Students must be 14 years of age on admission, and the school hours are from 8 a.m. to 7 p.m. in winter, and from 7 a.m. to 7 p.m. in

summer, with an interval from 12.0 to 1.30 for meals and recreation. The theoretical instruction comprises French, the elements of mathematics, geometry, and machine construction in their application to watch and clockmaking, the theory of the construction of watches, algebra and trigonometry, physics and chemistry, cosmography, book-keeping, and linear and industrial drawing. The practical instruction consists in the first year of the use of tools and roughing out work, in the second year finishing, in the third year escapements, and in the fourth year regulating and repairs. The pupils pay 12*l.* per annum, and find their own small tools. For the support of the school, the syndicate of watchmakers annually contributes 560*l.*, the Government 80*l.*, and the City of Paris 40*l.* Further particulars respecting this school will be found on pp. 22–3 of the First Report.

(2.) Apprenticeship Schools in Switzerland.

Switzerland.

No school of this character came under our notice in Switzerland, though we believe that in the watchmaking industry several small schools exist.

(3.) Apprenticeship Schools in Germany.

Royal Trade School, Iserlohn.

In most of the apprenticeship schools of Germany, that is, schools for the training of workmen or foremen, instruction in pure and applied art combined with practical work in the shops forms an important feature of the curriculum. The earliest attempt to introduce schools of a technical character into Germany was due, as is well known, to the initiative of Dr. Von Steinbeis, after the Great Exhibition of 1851. They have since spread over Southern Germany and Austria, and have recently been introduced into Prussia. Of these latter one of the best arranged is the *Royal Fach Schule of Iserlohn*, in Westphalia, a district abounding in ironworks and collieries, this being the first school of the kind established in Prussia. It is a school in which industrial art adapted to metal work is combined with handicraft teaching. The Commissioners visited this school under the guidance of Dr. Reuter, who was formerly director of the engineering school at Komotau (*see* p. 111), and it was in consequence of the success of this and of the other trade schools in Austria that similar schools have begun to be established in Prussia. The school owes its origin to the want experienced by the manufacturers of the district of better preparatory instruction of the pupils who enter their works. It has been established only four years. The pupils of this school go through a three years' course, and are trained as designers, modellers, wood carvers, moulders, founders, turners and pressers, chasers, engravers, gilders, and etchers. The drawing copies for ornament are published by Veith of Carlsruhe. The subjects of instruction are in part theoretical and in part practical. The theoretical instruction comprises drawing in all its branches, modelling in wax and clay, the elements of chemical and physical science,

Course for metal workers.

mathematics, German language, history of art metal work, and technology. The practical instruction includes lessons in the different departments of work which the pupil is likely to follow, each pupil being required to state on entry in which particular branch of the industry he is desirous of receiving special training. The hours of instruction are, in the morning, from 8 to 12 in the winter, and from 7 to 11 in the summer, and in the afternoon from 2 to 6. In this, as in other technical schools, it may be noticed that the hours of instruction are much longer than in schools in which there is little or no practical work, the alternation of mental and bodily exercise enabling the pupil to apply himself to school work without fatigue for a greater number of hours than is possible where the instruction is theoretical only. Workshop instruction.

An opportunity was offered of inspecting the work done in this school, through the courtesy of the director, who, at the request of the Commissioners kindly forwarded to London an exhibition of the school work, and this was on view for a few weeks at the Gresham College. The collection comprised specimens of modelling from sketches and photographs (some of which were executed by boys of 14 and 15 years of age) as well as specimens of wood-carving, wood-turning and metal work. Specimens of school work.

The school is well fitted with workshops, having the necessary appliances, including a six-horse power gas engine, hydraulic press, a planing machine, a shaping machine from Chemnitz, as well as elaborate lathes for wood-turning and metal-turning, made in Vienna, England, Scotland, and America. Workshop fittings.

The curriculum of the school instruction, which will be found in Appendix 7, Vol. V., is interesting as indicating the general scientific and artistic teaching which all the pupils undergo before devoting themselves more particularly to any branch of special practical work.

Besides the day school, in which the pupils are engaged from 8 to 10 hours, there is an evening school in which a course of instruction occupying three hours is given, comprising model and ornamental drawing, German, physics, and arithmetic. The instruction in the evening school is intended for the workpeople in the numerous manufactories of the district, and is almost wholly theoretical. 500*l.* was subscribed for apparatus, &c. by the leading manufacturers of the district. The school budget is 850*l.* Evening school.

' *Trade School at Remscheid.*—In Remscheid, a straggling town of about 30,000 inhabitants, 18 miles distant from Düsseldorf, a trade school has very recently been established for the instruction of apprentices in the construction of edge tools and other implements manufactured in the district, in which it competes with Sheffield and Birmingham. From this town, which a few years ago was a mere village, but is now growing and prospering in a high degree, an important trade is carried on, including some with our own colonies. The business is one conducted to a great extent in small shops, in the same way as the nailor's trade in the black country and the cutlery trade of Sheffield. In these Remscheid trade school.

separate shops sometimes as few only as two or three men are employed. These factories extend for miles into the country, and in them men are found at work making hand-vices, pliers, nippers, shovels, and other varieties of small hardware and cutlery.

Subjects taught.

The school established for the promotion of this industry occupies very fine new premises, which have been erected at a cost of 10,000*l.* At the date of the Commissioners' visit the school had only been in operation for ten days. There were present 18 pupils, some of whom were engaged in practical work in a smithy containing anvils and smiths' fires, whilst others were occupied in filing and chipping. All the pupils are taught drawing and design in its application to iron-work, and they are made familiar with the different kinds of iron-work that can be done by hand in small shops at their own homes. They are further instructed in the uses of the tools they make, and they learn something of the markets where they are sold, and of the methods by which similar articles are manufactured in other towns and countries. The students have the opportunity of studying in the school all the leading trade catalogues of the principal firms of their own and of other countries, and of thus familiarizing themselves with the drawings and descriptions of different kinds of tools. The main object of this school seems to be to impart to each student such an education as shall give him, on leaving it, an intelligent knowledge of the principles of his craft, a general acquaintance with the commercial requirements of the trade, and such skill in practice as may assist him on leaving school to at once earn his living.

Drawing made essential.

Objects of the school.

The morning hours are devoted to instruction in the ordinary school subjects, including the elementary principles of science, as well as drawing and design in application to the requirements of the trade, and the afternoon from 2 till 7 to practice in the shops. The fees paid by the students amount to 4*l.* per annum.

Höhr-Grenzhausen Pottery School.

Pottery Trade School, Höhr-Grenzhausen.—Another school of a somewhat similar type, which has been very recently established by the Prussian Government, is the Trade School for Pottery at Höhr, a small village about six miles from Coblentz. The village contains about 3,000 inhabitants, and its principal trade, as well as that of the neighbouring village of Grenzhausen, is the making of stoneware decorative pottery, in imitation of the old German stoneware, which was originally made in this district, and the art of making which was lost some centuries ago. The manufacture carried on in these villages is thus a revival of an ancient art. The clay is principally found in the district; indeed quantities of this clay are still exported to other parts of Germany, to Holland, and other countries.

School founded to assist a small local industry.

The school at Höhr has been founded for the advancement of this industry, and has been in existence about three years. The director, a native of the place, has studied in Frankfort and also in the Kunstgewerbe Schule of Vienna. The school is badly

housed in an old building, but plans have been prepared for the erection of a new and commodious structure. At present the school consists of a day school and an evening school. The day school is principally attended by sons of the small manufacturers, of whom there are many in the district. The evening school is attended by men and women of various ages, who are engaged during the day-time in the manufacture. At present there are 15 day students, and 16 evening male students, and 32 girl students, who attend also on Sundays.

The boys have already had some instruction in drawing in the primary schools, and many have also attended the Fortbildung or continuation schools, where they have increased their facility in drawing. The subjects taught in the school are drawing, designing, modelling in clay and wax, and working out new forms of vessels with original ornamentation, as well as painting, designing, and other branches of decorative art. There is also a general course of instruction on the manufacture of earthenware. Any new model completed by a pupil becomes the property of his father or of the manufacturer who places him at the school; but two copies of such model are given to the school. Plaster models are made from sketches supplied by the master, and the details are worked out in wax models, cast, and afterwards applied to the body of the article. Generally the modelling is taught in three stages. The pupil first models from a plaster cast, then from a drawing, and lastly from a rough sketch or idea. The lessons in modelling are given simultaneously with those in drawing. There are also lectures on the history of style, and of pottery, and the theory of colours. The school contains a carefully assorted collection of different kinds of stoneware and porcelain, including some of the original old German ware. Examples of Wedgwood and of other English wares are also present. The assortment of models in wood and plaster is good and varied.

Subjects taught.

The school course occupies three years, and is given daily, Saturdays excepted. The pupils of Grenzhausen and Höhr pay 20 shillings a year for the day school, in which 30 hours' instruction are given per week, and 4 shillings for the evening school, which meets four times a week for two hours. Pupils from other localities pay 30 shillings for the day school.

From information obtained from one of the resident manufacturers, whose works the Commissioners visited, it seems probable that this school is likely to be of considerable benefit to the industry of the district. The Commissioners observed that although the school had been in existence only a very short time, some of the new patterns which were being manufactured in the neighbourhood had been originally designed and modelled in the school.

An interesting fact bearing upon the pottery industry of Germany was observed at the large manufactory at Poppelsdorf, near Bonn, where a number of boys of about 14 years of age were employed in drawing and painting rough designs on cheap earthenware and porcelain. These boys, who had received no other instruction in drawing than that which they had gained at the

Appreciation by manufacturers of drawing.

primary schools which they had previously attended, had there obtained sufficient facility in drawing to enable them at once to earn about three shillings a week as working apprentices. The director of the painting shop spoke in the highest terms of the advantage which the boys derive from the instruction in drawing which they obtain in the primary schools, and of the skill which they bring with them to the works. No apprentices are received into this department of the works unless they present a certificate of efficiency in drawing from the master of the school which they have previously attended. Of these boys, those who exhibit artistic power are subsequently trained by the artist employed in the works, and are then employed on designs of a higher character. These facts are mentioned to show the advantage which the pupils in Germany derive from the excellent drawing instruction which is given in the primary school; for there can be little doubt that the common class of goods manufactured at these works and largely exported to England were made more cheaply than they could be made in this country, because of the artistic skill of young apprentices, who had obtained their art instruction in the primary schools, and were employed at very low wages in decorating them.

Effect of the teaching of drawing on the pottery industry of Germany.

Trade school of Cologne.

The Gewerbliche Fach Schule of Cologne is a school for the sons of tradesmen and superior artizans, and is of a somewhat special character. It is divided into three departments, engineering and architectural drawing, modelling, and decoration, including house painting. There is a summer session and a winter session, the latter being the better attended, as some of the young men go into practical work during the summer months. The course of instruction is specialised for certain trades.

In many of the other German States, schools of a similar character to the foregoing were visited by the Commissioners. We may mention the following, of which a more detailed account appears in the Appendix.

Apprenticeship and trade schools in the Black Forest.

Schools for teaching Industries in the Black Forest.—The district of the Black Forest, situated in the Grand Duchy of Baden, is well known as being the seat of a large number of home industries, and as containing schools for the instruction of apprentices and workmen in these various trades.

Amongst the schools of this kind visited by the Commissioners the more important are those for clock-making, carving, and straw-plaiting. A special report on the schools and industries of this district will be found in Appendix 1, Vol. I., from which the following abstract has been prepared.

Clock-making school at Furtwangen.

The Clock-making School at Furtwangen. — This school is intended for the technical instruction of clock-makers, an industry for which the district has long been famous, no less than 13,500 people, amongst the population of upwards of 90 parishes, being employed in this work. A Government grant of 660*l.* was made for building the school, and the local trade society is about to erect an extension at a cost of about 1,500*l.* There are 18 pupils, nearly all of whom are admitted free, some being supported

by exhibitions subscribed for by the neighbouring towns. The course, which extends over one year, consists of the ordinary theoretical subjects, together with drawing and the technology of watch and clock-making, supplemented by 30 hours per week of practical work in the shops.

Straw plaiting

Another industry of the neighbourhood is that of straw plaiting for hats, baskets, &c., and at Furtwangen a special government school has been established, while, in addition to this, similar instruction is given in straw-plaiting in many village schools during the winter months. Samples of work done in the school are exhibited in the Gewerbe Halle of Furtwangen.

Wood-carving.

A third important industry carried on in this district is that of wood-carving, for which a school exists in the above town, containing about 30 pupils, who go through a regular course of drawing, modelling, and wood-carving. The local authorities provide the premises, and the State pays the teachers and furnishes models, examples, and plant. The boys, in addition, attend the classes of the trade school (Gewerbe schule) for theoretical studies. There is in addition, at Furtwangen, a joiners' school for training cabinet makers, to which the pupils of the carving school are sent one day per week to learn the general principles of furniture construction.

Joiners' school.

Industrial schools in Bavaria.

Bavarian Industrial Schools.—Village industrial schools similar to those described for Baden exist throughout Bavaria, and these, like the former, are destined to assist and promote local industries. They may be classified under the following heads :—

1. Weaving schools.
2. Wood-carving „
3. Basket-making „
4. Pottery „
5. Violin-making „

A description of the work done in these schools, which was inspected by the Commissioners at the Nuremberg Exhibition, will also be found in Appendix 1, Vol. I.

Home industries in Thuringen.

Thuringian Home Industries.—The district of Thüringen in Saxony contains more varied industries than the Black Forest, but the number of special schools is smaller than either in Baden or Bavaria. In Sonneberg, which is the centre of the toy manufacturing district, specialised instruction is given to the work-people in the trade continuation school (*Fortbildungsschule*), especially in drawing, modelling, and carving, the classes being held from 6 to 8 in the morning.

(4.) Apprenticeship Schools in Austria.

Austrian apprenticeship schools.

In Austria an extensive movement has been recently set on foot by the Government to establish apprenticeship schools, and the latest reports show that there are now in Austria 84 trade schools (Fachschulen) for the teaching of various industries. These schools are chiefly situated in small provincial towns, remote from the capital. Many have been founded by the

various trade societies (Gewerbevereine), of which there are upwards of fifty in Austria.

These schools may be divided into five classes:—1. Schools for textile manufactures; 2. for wood and stone trades; 3. for ceramic and glass trades; 4. metal industries; 5. for toys and various small industries. A description of a few of these schools will indicate their general aims. The schools of this class belonging to the Lower Austrian Trade Society (one of the largest and most influential of the trade associations above referred to, which has its offices and headquarters in Vienna) are two in number; namely, a school for carpenters, and one for weaving and dyeing;* the latter will be described in detail when we come to treat specially of this class of schools. A third school, for mechanics, is about to be established by the Society on the model of the one in the Boulevard de la Villette at Paris.

Joiners school, Vienna.

The Joiners' School, Vienna.—The school for joiners and wood-carvers, is mainly a winter school. It is organized and controlled by the Trade Society but receives a grant of 500*l.* a year from the Government. The school building belongs to the city and is granted to the Society at a low rental. This is not a free school, the fee being 16*s.* 8*d.* per month. The full course of studies lasts 3½ years; after the expiration of which time the students are supposed to be fitted for the position either of skilled workmen, foremen, or teachers. As in all the other schools, drawing is the chief subject, and is taught both during the day and in the evening. Practical work of a high character is carried on in a fully equipped cabinet maker's shop, where at the time of our visit, the students, 20 in number, were engaged in working at the bench.

Trade school at Riva.

School for Wood Working at Riva, Tyrol.—Of the provincial wood carving schools, we may select that at Riva as one of the best examples. It aims not only at giving an industrial training, but also a general education; the boys spending the morning in the class-room, and taking industrial work in the afternoon. As in other schools, drawing is made a most important feature, and modelling is also taught to all the students, the director being strongly of opinion that mere workshop schools, without the necessary provision for theoretical instruction, are useless.

Beneficial influence of apprenticeship schools in Austria.

Dr. Exner, the Secretary of the Lower Austrian Trade Association (to whom we are indebted for many acts of kindness), and who is the Government Inspector of the *Fachschulen* for woodwork, and a member of the Austrian Parliament, gave us many very interesting particulars concerning the beneficial effect of the schools in various parts of Austria. He stated that in some cases new industries had been created by the action of such schools. For instance, at Arco, near the lake of Garda, in the Tyrol, he found that olive wood was being used as fuel; a small

* The report on the weaving school will be found on p. 145.

school was established with five lathes; an instructor was provided, and the children were taught drawing and modelling as well as practical work. This instruction had resulted in the erection of two factories, all the workmen in which were trained in the school, and the place is now the seat of a small but flourishing trade.

Trade school at Arco.

The Commissioners on visiting the school at Arco found the above statements were fully borne out. A detailed account of the interesting work carried on at Arco will be found in Appendix 1, Vol. I. Schools of a somewhat similar character have been visited by the Commissioners at Villach, Cortina, Innsbruck, and Salzburg (for a detailed description see the above Appendix).

Fachschulen have been created to remedy the acknowledged defects of the apprenticeship system, and Dr. Exner thinks that, apart from the introduction of new handicrafts, their effect has been to develope industry to a great extent in Austria. They have in some instances served as models for the very recent establishment of similar schools in Prussia.

(5.) Apprenticeship and Artizan Schools in Belgium.

Belgian Industrial Schools.

The aim of these schools, as explained to us by the Minister of the Interior, is to give to the workman a scientific instruction which he is unable to obtain in the workshop; to procure for him the means of improving his material condition and of developing his intelligence; to lead him gradually away from the tyranny of routine; and to increase the economic value of his labour, and thus to put him in a position to contribute to increased production to his own and to the national benefit.

These schools are carried on every evening in the week, generally from 7 to 9.30, and for three hours on Sunday mornings. They are free, and are mainly supported by Government and municipal grants.

From 1840–1844 the number of communal industrial schools subsidised by the State was only five, whereas in 1881 there existed 34 of these schools, not counting the Provincial Industrial School of Hainault, established at Mons, and the Superior Commercial Institute of Antwerp.

Course of instruction.

There is no prescribed course or uniformity in the programmes of these schools. The instruction varies greatly in the different schools, being developed in accordance with the requirements of local industries. The general course comprises the French or Flemish language, according to the geographical position of the school, arithmetic, commercial arithmetic, geometry, elementary notions of technology, physics, chemistry, mechanics, the laws of health, and industrial economy. Together with these are certain special classes calculated to enable the workmen to obtain certificates for competency in various branches of industry.

Drawing the basis of all instruction.

Drawing is the basis of all the instruction, and is regarded as the universal language. The lessons in this subject follow a graduated course, and are founded on drawing from the round.

Belgian system of teaching drawing.

The following extract, for which we are indebted to M. Rombaut's Report, will give an idea of the peculiar method of teaching drawing adopted almost universally throughout the Belgian evening schools.* When the workman arrives at the school, his hands having been rendered clumsy by the coarse work which has occupied him during the day, it is necessary first to lead him to obtain delicacy of touch, while at the same time giving him exact ideas of dimensions. In order to do this, black-boards are in each class room fixed against the walls, each pupil having placed before him a square metre of black-board surface. The teacher shows him how to draw with chalk, without the aid of any instrument, various forms of lines, straight, inclined, curved, and their various combinations. It is only when the workman has thoroughly acquainted himself with the idea of these lines by the use of chalk that he begins to draw with charcoal on paper. This instruction lasts about a year, being carried on every evening of the week, after which the pupil passes on to the study of projection and ornament. This leads him up to industrial drawing bearing on his special trade, as also to original designing and drawing to scale. The instruction is given at night after the termination of the day's work. The duration of each lesson is one hour, two hours being employed each evening, one hour of oral instruction always preceding the drawing lesson. The course lasts from three to five years, according to the locality and the importance of the subject. On Sundays the instruction is given throughout the morning. The last hour is generally devoted to a lecture given in the form of a discussion, which is open to the public. These lectures include industrial economy, constitutional law, and hygiene.

Number of scholars.

The total numbers of scholars in these schools in the year 1878 (the last in which complete returns have been made up) will be seen from the table in Appendix 9, Vol. V. to have been 8,387, out of a population of 5½ millions.

Brussels Industrial School.

The École Industrielle of Brussels is housed in the basement and ground floor of the Royal Industrial Museum. In this school not only is evening instruction given, but there are also day classes for architects and mechanical draughtsmen. The school contains chemical and physical laboratories, and is especially characterised by its valuable industrial library, which is open to the public. The building is wholly inadequate for the purposes of the school, the collections being mainly arranged in damp cellars, and the class-rooms being insufficient for the accommodation of the pupils; and hence the school is not altogether so successful as might be wished.

Antwerp Industrial School.

The École Industrielle d'Anvers (Nijerheid-school van Antwerpen voor Werk en Ambachtslieden) is an evening school for workmen, who go through a definite course of instruction, having lessons in geometry, elementary science, and in drawing in its

* See Report by M. Rombaut, Inspecteur de l'Enseignment Technique, on Industrial and Professional education in Belgium.

special application to various trades. The teaching is free, and is given in the Flemish language. In addition to the general course of instruction, which all the students of this school, as of other similar schools in Belgium, are expected to follow, the Commissioners found classes in which workmen are taught various special trades, such as wood-graining and painting in imitation of marble; these being industries carried on in the city of Antwerp. 27 pupils were at work in this class. The school contains 150 pupils in five classes. They enter at the age of 14 and upwards, and remain four or five years. By a special ministerial decree, children from the primary schools, who can satisfy the conditions of entrance, are admitted at the early age of 12 years. Most of the pupils, however, have already spent more or less time in the workshop, and have therefore gained some familiarity with the practical details of their trade. The lessons take place between the hours of 6 and 9 every evening. The present building is very antiquated, and the school has been in existence for 18 years. A new building is about to be erected. Here, as in almost all other schools in Belgium which the Commissioners visited, special attention is paid to drawing, the system being similar to the one already described.

Number of pupils.

New building projected.

It is worthy of notice in connection with this school, as well as with other schools in Belgium, that the pupils are expected to go through a complete course of instruction as laid down in the programme for each year, and do not select such subjects as they themselves may consider to be more especially applicable to their own work. There is a preparatory course for young men who are not sufficiently advanced to enter the school. The annual cost of the establishment is 900*l.*, part of which is contributed by the town and part by the province and by the state.

Pupils follow a complete course.

The Ecole Industrielle of Ghent, also visited by the Commissioners, may be taken as a type of others of a similar class inspected by them, amongst which was that at Verviers. The school is housed in a fine and commodious building, which has recently been erected. Classes are held in this school, both in the day and in the evening. The school is divided into four sections. Certain classes, among which is one for practical chemistry, meeting every Sunday morning from 11 to 1, and language classes, especially English and German, held in the evenings from 8 to 9, are common to all the sections.

Ghent Industrial School.

The first section is especially designed for workmen. The course in this section is given on Sunday morning, and on Monday after 5 o'clock; most of the works at Ghent closing at half-past 4 on Mondays for the purpose of enabling the young workmen to attend the school. The lessons in this section are given altogether in Flemish, and include book-keeping, arithmetic, the elements of algebra, plane and descriptive geometry, land-surveying and levelling, physics, chemistry, mechanics, steam, linear drawing and its applications to machine drawing and building construction. The drawing classes, however, are given

Workmen's section.

Sunday drawing classes.

not only on Sunday morning, but also on four evenings of the week from 6 to 8, and they are common to the four sections of the school.

Foremen's section.

The second section is intended for foremen, clerks, employés, managers' sons, &c., that is to say, for young persons who have received a middle-class education, and are employed in industry, commerce, &c. The instruction is a stage higher than in the first section, and the courses are given in French, on every evening in the week from 6 to 9. The subjects include book-keeping, physics, chemistry, technological chemistry, mechanics, machine drawing and construction, drawing, and industrial economy.

Weaving school.

A third section is the *weaving school*, forming one of the *Ateliers d'Apprentisage*, the reason for the existence of this special school being that Ghent is the centre of the two great textile industries of cotton and flax, the course here having special reference to these manufactures. The pupils in this section attend lectures on weaving, and work practically at the loom. The workshop contains a considerable variety of looms, of which four or five are power-looms driven by a steam engine. The pupils are expected to attend the weaving school every day from 9 to 12 and from 2 to 5. At least three afternoons per week are devoted to ornamental designing and to putting the design on the loom. In the evening the pupils follow the various courses of the second section. The weaving course is a three years' one. The first two years are devoted principally to mathematics, the elements of physics and chemistry, mechanical drawing, and the principles of weaving, and the third year to the more special application of these subjects, and includes instruction in chemical technology, spinning, and practical work in the sheds.

For various reasons, including, among others, the inability of many of the pupils to devote two or three years to the study, without bursaries (which are not yet forthcoming, but which it is hoped will be shortly established), this department of the school is not well attended, and does not altogether satisfy the expectations of its founders. The Atelier d'Apprentisage at Thielt, however, a school of a somewhat similar character, is in a very flourishing and active state.

Industrial art school.

The fourth section is the special *industrial art school*. The object of this school is to train (1) designers for textile fabrics of all kinds, for lace-making and embroidery, and for furniture, bronze, and goldsmiths' work; (2) ornamental modellers for house decoration; and (3) decorative painters. The pupils of this section attend the schools of drawing, painting, and modelling, during the day, from 9 to 12 and from 2 to 5; they also visit the evening courses on weaving, and they may likewise have instruction in book-keeping, English, and German. The course lasts from three to four years, according to the aptitude of the pupils and their knowledge of drawing.

An interesting department of the institution is the school of photography, to which an addition has recently been made in the form of a photographic studio, having especial reference to the applications of photography to art industry. The pupils attending this department are usually engaged in some branch of the printing trade. In the winter a course of lectures is given on the principles of photography, and in the summer the class practises the various operations connected with photo-lithography and other applications of photography to printing purposes. School of photography.

Other special courses of lectures are given in this school; one of these being on the industrial applications of electricity, a subject which is now attracting much attention. Another, which, it is claimed, was the first of its kind in Europe, is one on Heat for steam-boiler stokers. Lectures on other subjects.

The Commissioners attended a lecture on elementary chemistry, by one of the Professors of the University of Ghent, and they were struck with the excellence of the teaching.

It is a condition of admission that the pupils must be 14 years of age, unless under special license from the director. They are all externes, and all the courses are gratuitous.

We append tables showing (1) the ages of the pupils, and (2) their several occupations, for the year 1881–82.

I

Ages of pupils.

From 14 to 17 years of age	502
„ 18 „ 20 „	253
„ 21 „ 23 „	117
„ 24 „ 26 „	51
„ 27 „ 30 „	30
Above 30 years of age	26
Female students	10
Total	989

II.

Occupation of pupils.

Manufacturers' clerks	138
Mechanical draughtsmen	11
Painters, decorators, and carvers	90
Teachers	18
Students and schoolboys	168
Stokers	13
Fitters and engineers	45
Smiths and locksmiths	74
Iron turners	32
Carpenters, cabinet-makers, &c.	118
Soldiers	23

Dyers and spinners - - -	33
Printers - - - - - - -	14
Stone and marble masons - -	8
Employed in chemical works - -	15
Various professions - - -	144
Mechanics of no specified trade - - -	35
Female students - - - -	10
Total - - -	989

The total annual expenditure is 2,010*l.*, of which 1,534*l.* is spent in salaries of staff.

Liége Industrial School.

In a similar school, the *École Industrielle* at Liége, also visited by the Commissioners, very great attention was devoted to the teaching of mechanical drawing, particularly in its applications to the special trades in which the students are engaged. Many of the teachers have been draughtsmen in architects' or engineers' offices, and in all cases they were practically acquainted from personal experience with the details of the industry in connection with which the drawing instruction was being given. Special attention is likewise paid to the elements of industrial chemistry and metallurgy, applied mechanics, building construction, and mathematics.

Diplomas.

The school gives three special diplomas to the first student of each of these three latter sections.

New school in course of erection.

The Commissioners found the school accommodated in a very poor and inadequate structure, and the utter insufficiency of the accommodation, which was eloquently complained of in the Report on the condition of Industrial and Professional Education in Belgium, presented to the Legislative Chamber in 1879 by the Minister of the Interior, resulted in the determination of the municipality to erect a commodious building capable of providing for the greatly increasing number of applicants desirous of profiting by the special technical instruction. The new building which the Commissioners visited, and which has since been opened, has been erected at a cost of about 20,000*l.* It contains very large chemical and physical laboratories and lecture rooms;

A model building for industrial school.

numerous spacious drawing-rooms for freehand, linear, and architectural and machine drawing; a museum for collections for purposes of instruction, a library, rooms for teachers and director, and, in fact, may serve in every way as a model building for an evening industrial school. We were so satisfied with this building that we thought it might be serviceable to append drawings of it, which are contained in the Appendix, Vol. V.

Occupations of the students.

The Commissioners were so much struck with the excellence of the drawing carried on in the school, especially in the elementary stage of freehand drawing, that they requested the professor, M. Thomas, to furnish them with a statement of the occupations of the students (numbering 121) at work on the

occasion of their visit. From this information, which has been supplied through the kindness of M. Magis, the alderman in charge of instruction in the city, the following list has been compiled: moulders, 9; strikers, 2; mechanics, fitters, &c., 14; engineers, 8; armourers, 7; telephone fitter, 1; locksmiths, 7; wheelwright, 1; tinsmith, 1; carriage fitters, 2; wood turners, 4; joiners and cabinet makers, 21; masons, 7; painters and stainers, 3; tracers, 5; modellers, 4; shoemaker, 1; baker, 1; cigar maker, 1; merchant, 1; shop assistants, 8; farmer, 1; gardener, 1; soldiers, 2; students and schoolboys, 9.

Louvain Industrial School.

The *École Industrielle, Louvain.* At Louvain, a town of 35,000 inhabitants, there is an interesting school of the same kind. The teachers of the school thoroughly understand the kind of instruction which is required for workmen, and by omitting the dry details of a purely scientific education, are able from the very commencement to engage and retain the attention of their numerous students.

The Commissioners were introduced by M. de Taeye, the Government inspector of these schools, (who has devoted much attention to the methods of teaching drawing, and whose system is about to be adopted throughout Belgium),* and had the opportunity of making a close inspection of this establishment.

This school was founded in the year 1876; it is located in the same building as the Academy of Fine Arts, and the two establishments are placed under the same direction.

Excellence of drawing.

A remarkable feature of this school is the excellence of the drawing, which comprises freehand drawing, study from the cast, sketches of large models, ornamental figures, and drawings of the elements of machines as well as of the machines themselves. The drawing is carried on in large and commodious rooms formerly belonging to one of the old colleges of the University. The school also contains a large and excellent collection of machine models manufactured by Schroeder of Darmstadt.

Absence of manual work in the Belgian trade schools.

The Commissioners noted that in none of the above-mentioned schools, which are specially designed for workmen who are engaged during the daytime in their various handicrafts, is manual instruction given in mechanical work. They learned from the Director for Agriculture and Commerce that at the Industrial School at Tournai such instruction is given, but that the success which has attended it has not been sufficient to justify the extension of this system to other evening industrial schools.

Belgian weaving schools.

The Ateliers d'Apprentissage.—A class of schools, principally day-schools, for the technical instruction of artisans, are the so-called *Ateliers d'Apprentisage* of Belgium, of which there are at present 58. These schools were founded about 1847 to 1850 when the flax industry in Flanders and other parts of Belgium,

* *See* Traité General de l'Enseignement des Arts du Dessin par Louis de Taeye.

owing to the introduction of power looms, was in a very critical state. They have now served their purpose, and are carried on at the present time, with few exceptions, as ordinary weaving sheds, employed by contractors. We allude to them further in the chapter on Weaving Schools, p. 125.

(6.) Apprenticeship Schools in Holland.

Dutch artizans' or Ambachts schools.

The artizans' or Ambachts schools of Holland, which have been established by private effort for the training of workmen, date back about 20 years.* They all receive Government aid, but depend for their maintenance, to a certain extent, on local subscriptions. The chief of these schools are at Amsterdam, Rotterdam, The Hague, and Arnheim. There are about 8 or 10 of them in all, and we were informed by Dr. Steyn Parvé that they were doing excellent work, and were in a flourishing condition; we visited two of them, those of Amsterdam and Rotterdam.

Former middle-class schools were not well supported.

It was found that the lower middle class schools, contemplated by the law of 1863, in which only a purely literary instruction was to be provided, were not by any means heartily supported, and, owing to the decay of apprenticeship, it was felt that some proper training should be provided for the children of those parents who could afford to maintain them for a few years after the completion of their elementary education, during which they might receive better instruction than could be gained in the ordinary workshop. As soon as local effort had supplied this want, the Government authorities permitted these new schools to take the place of the middle class schools, the foundation of which was made obligatory by the recent law. Following the example of Amsterdam, the town of Rotterdam opened a school of this kind, and the success there obtained encouraged other localities to found schools of this type. The school of The Hague was opened in 1873, that of Arnheim in 1874. At Amsterdam and The Hague professional schools have also been established for girls.

Ambachts school, Amsterdam.

The Ambachts School, Amsterdam.—This school, which was visited by the Commissioners, was founded by private initiative in 1861, for the purpose of teaching the handicrafts required in house and ship building. Candidates for admission must be at least 13 years old, must produce a certificate of good conduct, and must have received a satisfactory elementary education. The students are admitted by patronage, or by an annual payment of 24*s*. In this trade school, as in that of Rotterdam, the general education is continued, and special instruction is given in algebra, geometry, mechanics,

* The first school of this type in Holland was founded in Amsterdam by the Working Men's Association (*Maatschappij van den werkenden stand*) in 1860 It was subsidised by the town and, in addition to giving a literary instruction, possessed workshops for teaching carpentry, joiners' work, smiths' work, painting, &c.

physics, and the use of machines, tools, and building materials. Instruction in drawing forms an important portion of the curriculum, and includes lineal, ornamental, and decorative drawing, drawing from nature, and architectural drawing. The students work in the shop, 16 hours weekly, at carpentry, forging, turning, and carving. The course of instruction extends over three years. Of the 160 pupils in attendance at the school, 108 are in training to become carpenters, 36 smiths, 9 cabinet makers, 3 sculptors, 2 turners, 1 house painter, and 1 engraver.

Students who distinguish themselves by their diligence, good behaviour, and special progress, receive certificates of recommendation by which they are particularly brought under the notice of masters of workshops and other employers of labour.

The annual expenses of the school amount to 1,600*l.* Towards this the city contributes 800*l.*, the province 480*l.*; private subscribers, 160*l.*, and the remaining expense is borne by the society which founded the school.

Ambachts school, Rotterdam.

The Ambachts School, Rotterdam.—This school was established in 1869 by the Rotterdam branch of the Netherlands Architectural Society, in order to train skilled artizans, and thus to remedy the acknowledged defects in the system of apprenticeship. It receives an annual grant from the Town Council, on condition that the programme includes all the branches of theoretical instruction recognised in the three years' course of public middle class schools. The funds necessary for the foundation of the school were subscribed voluntarily; a building was purchased, and the institution was inaugurated on April 1st, 1869. The main building contains the various class-rooms; the director's residence and the workshops have been constructed round a small open court in the rear. As the object is to train workmen well versed in the practice of the various trades, the boys are as far as possible engaged on useful work, capable of being sold or employed in the school.

System of workshop training.

As soon as the boys have learnt the use of the various tools, they begin to make small articles which have a marketable value, and thus realise that they are working with a view to the commercial results of their labour. It has been found, from experience, that his being engaged on a bonâ-fide piece of workmanship serves as a powerful stimulus to the pupil. The workshops are as far as possible kept up to the level of modern requirements, and have frequently been extended to accommodate the increasing number of students. They comprise shops for carpenters, blacksmiths, metal workers, fitters and turners, cabinet-makers, masons, and stone-carvers.

The articles made in the school are sold to dealers, and orders are also executed for the municipal authorities. At the time of our visit, the carpenters were engaged in carrying out a large order for the desks of a primary school. Many doors, window frames and fittings are made for builders. The metal workers were making locks, hinges, shovels, hooks, smiths' tongs; also stoves

and coal scuttles. The lads in the shops work under the direction of practical foremen. The school hours in summer are from 8 a.m. to 7 p.m., or till 6 on Saturdays, and in winter (September 1st to March 31st) from 8 a.m. to 5.30 p.m. The mornings are spent in the class-rooms, and the afternoons in the shops. The time table of this school is given in Appendix 10, Vol. V. The general instruction is in continuation of the ordinary teaching of the elementary school; the teachers bear in mind that the boys are to become artisans, and the examples are therefore taken as much as possible from their future profession. Drawing is carefully taught and is made thoroughly practical. The boys begin with copying rectilinear and curved figures and simple ornament from casts. In the architectural course, as soon as they have acquired sufficient skill, they draw details of construction, and make measured drawings from actual work. In the advanced class they learn mechanical projection and simple perspective as applied to architectural details and parts of houses. The staff comprises Mr. D. de Vries and 20 masters and assistants. There are over 280 boys, who pay 8*s.* 4*d.* per annum for instruction, and the fees are readily remitted to poor parents. The full course lasts 3 years. Boys from 12 to 15 years of age, who have completed their education at the primary school, are eligible for admission, and when they have completed their full course of three years they are under the patronage of the school committee, who find them situations for five years longer. It has been found that these lads, on leaving the school, readily earn good wages and are paid more than apprentices who have been trained in the usual way. The school is maintained partly by subscription and partly by grant from the town of Rotterdam, the province, and the State. The school budget is about 2,500*l.*, the Government grant being 1,750*l.* and that of the province 166*l.*

(7.) Apprenticeship Schools in Italy.

Some of the technical institutes most nearly resemble the schools of this type, but of apprenticeship schools proper we found no examples in Italy.

Conversations on Artizans' Schools.

Workshop schools in Bavaria.

In bringing the portion of our report concerning artizan's technical schools to a conclusion, we may here insert the substance of conversations which the Commissioners held with various competent persons, on the question of the technical instruction of the foreign artizan. We were informed by Mr. Fenton, the First Secretary of the Legation at the Hague, that he was Secretary of the Legation at Munich at the time of the building of the great Polytechnic School of that city, and on three occasions he reported on technical education in Bavaria. Some few years ago there was no workshop teaching in any of the schools of that country. It was then considered that it was no business of the school to trench upon the province of the workshop. He believed that the views of many German educationists were becoming some-

what modified on this question, and that they were finding that the workshop could help the school just as the school could help the workshop. Just in the same way as the laboratory illustrates the principles of chemistry, so the actual machine or mechanical operation often illustrates the principles of mechanics, and in each case the student without practical illustrations would less rapidly acquire the knowledge which he seeks.

With regard to the comparison between English and foreign workmen, Mr. Fenton stated that, after a long experience of the Continent and close observation in several countries, he has found no workmen comparable with the English, and if the English workman with his physical strength and force of character will cultivate his intelligence, he will still further distance the foreigner.

Conversation with Mr. J. Diefenbach, Regierungsrath, Stuttgart.

We met Mr. Diefenbach at the opening of the Exhibition at Nuremberg, to which he had been invited as representing the Education Department of Wurtemberg.

No workshop schools in Wurtemberg.

He informed us that there are no workshop schools in Wurtemberg like the apprenticeship schools of Paris or the industrial schools of Bavaria. The authorities have held that the best place for teaching a trade, or manual labour in any form, is the workshop. But they believe, as ardently as any of the promoters of technical education, that science and art are subjects requiring to be taught to the workman, and that a knowledge of theory should, as far as possible, go hand in hand with practice. The all-important problem with them has been (1) how to give a sound education to all the young artizans as they grow up, and (2) to do so without interfering with their daily labour. They are attempting to solve this problem by the establishment of evening and Sunday schools, and by insuring the attendance of artizans at these schools. The evening schools are similar in many respects to the Fortbildung schools of other German states, and are established everywhere in Wurtemberg. The curriculum is arranged to suit the wants of the apprentices and workmen in each locality. In Wurtemberg a boy leaves school at 14, and becomes an apprentice till 18. (Although this is the usual term, Mr. Diefenbach considers it is much too short for learning a trade.) During his apprenticeship he attends the Fortbildung school, which supplements his earlier education in ordinary literary subjects, and teaches him the sciences bearing upon his trade, and drawing. The more advanced students pursue methods very similar to those of the Science and Art Department in England, with which Mr. Diefenbach is familiar. The backward students, who cannot take up science without some preparation, begin their evening instruction at the beginning; the ultimate aim of the schools is to teach that which will best help the student in his daily life and labour.

Existence of local school boards in Wurtemberg.

In Wurtemberg, whilst the day schools are organised and controlled by local school boards, the Fortbildung schools are managed by a Commission, composed of members of the town

council and the local Gewerbevereine, and are maintained, half by the town, and half by the State, and are free to the students.

Government inspection and examination.

There are yearly examinations, theoretical and practical, which are publicly advertised, and any persons can sit, whether they have attended the public schools or not. The theoretical examination is held in the school, in the presence of the Commission. The practical examination is held in some workshop, under a Government inspector thoroughly conversant with practical work. On the judgment of the examiners in practice and theory, diplomas are granted to which great value is attached by the students, as they help them in obtaining situations.

Science teachers not paid by results, but by fixed stipends.

The science and art teachers are not paid by results, as under the South Kensington system. Mr. Diefenbach considers this an advantage, as the teacher is relieved from the anxiety of trusting to the whims of careless students in order to obtain a precarious income. The pay of the teacher is usually 2s. per hour for evening work, be his students many or few.

Evening schools: co-operation of employers and parents.

Employers take an interest in the night schools, and note the attendance of their apprentices by the registers which are sent to them. In cases of absence without justification the employers of the apprentices are duly informed. There is no compulsion to attend night schools as in some other parts of Germany, but attendance of apprentices is, in a great degree, assured by the cordial co-operation of employers and parents. The latter are fully conscious of the importance of having their children educated, while the former give preference to those who are regular and painstaking in their school work. We were assured that, as in England, there is an indisposition on the part of employers to interfere with their workpeople after work hours; in fact, unless judiciously managed, such interference would be resented, but the question of school attendance is managed with sufficient delicacy to disarm all opposition.

As an organiser of evening schools, Mr. Diefenbach does not favour direct compulsory attendance; from a teacher's point of view, in particular, compulsion is not desirable. Pupils anxious to get on are a delight to the teacher, but idle and unwilling pupils are a nuisance, and keep back a whole school.

Trade Societies in Wurtemberg.

On the question of industrial associations (Gewerbevereine), his information was interesting and important. They are voluntary institutions, and in Germany there is scarcely a town without them. They aim at promoting the spread of knowledge and culture in the several localities, and in this respect resemble the Mechanics' Institutes of England. They also interest themselves, like Chambers of Commerce, in increasing facilities for trading, improving communication between different towns, giving protection to inventions, &c. They raise funds for exhibitions, entertainments, excursions for worn-out or disabled workmen, and take the initiative in any movement for improving or amusing the people.

The members pay a small subscription; in some towns as much as 20*s.* to 30*s.* a year, in others as many pence. They often meet in taverns when they have no rooms or clubs of their own. Many foremen and workmen are members, on terms of equality with their employers.

Education of the artizan and the prosperity of the State connected.

Mr. Diefenbach summed up by saying that his Government is of opinion that, for securing the permanent prosperity of the State, the most important education is that of the artizan. The work of the world is done by him, and that nation which educates the artisan will excel in industry and manufactures. Is it not true that in nine cases out of ten the great inventions and improvements in machinery come either from the workers themselves or from those who have gone through the artizan's training? Yet the artizan of all men has the least choice as to his own education or that of his child. The rich man can send his child to any town or country, and can select the school most suitable for his wants. The artizan's poverty precludes choice, the school must be near his home. It is, therefore, all the more important that it should be a good school, not for the sake of the individual only, but for the sake of the community. It is in accordance with these views that the education of Wurtemberg is framed and administered.

III.--INTERMEDIATE TECHNICAL SCHOOLS FOR FOREMEN AND DEPARTMENTAL MANAGERS.

Education of foremen abroad.

Having considered the means of instruction available in the countries we visited for the education of those intended to become workmen or to occupy the lower grades in industrial establishments, we now pass on to our next subdivision, which includes schools of a higher grade, in which technical instruction is imparted either as a sequel to, or in conjunction with, a secondary or even superior education. This section comprises a very numerous series of differently constituted institutions, varying widely in their aim, and difficult of classification in groups. They afford education in many cases, not only to the most promising pupils of the elementary schools, destined to enter life as workmen, but also to the children of foremen, tradesmen, and small manufacturers. Their object is, in most instances, to prepare young men for intermediate posts in industrial occupations. For the sake of clearness we propose to treat of these schools under the following heads, selected with reference, as far as possible, to the main objects such schools are intended to serve, namely,—

Grouping of intermediate technical schools.

I. General technical schools, together with those in which the instruction is specialized for building, mechanical engineering, and mining;
II. Weaving schools;
III. Industrial Art schools.

I. General Technical Schools.

General technical schools abroad.

In the first of these divisions we include a number of schools difficult of independent classification, which are intended to give an education embracing a rather wide range of subjects, in which technical and secondary education are combined with reference to one or more industries. Most of these schools are of a general character, and they are of different grades, some of them affording education to boys of from 10 to 15 years of age, and others to youths of from 15 to 20. The character of the technical instruction they impart is determined to a great extent by the requirements of the district in which the schools are situated. A large number of such schools are divided into three departments, two of which, the mechanical and chemical, are common to most of them, and the third is either for building trades, commercial, textile, agricultural, or nautical students, according to circumstances.

This classification cannot, moreover, be understood as being by any means very rigid; it has been adopted for convenience of description and comparison. Many of these schools contain departments which would fall more properly under some of the special classes into which we have divided this group of institutions. In some of them weaving, dyeing, and other trades are practically taught. In our detailed examination of these schools we have endeavoured to class them according to their grade, rising from the more elementary to those more advanced. We may proceed to deal with them under the three following heads:—

A. Higher Elementary Technical Schools;
B. Secondary Technical Schools; and
C. Building, Engineering, and Mining Schools.

A. Higher Elementary Technical Schools.

(1.) In France.

French Higher Elementary Technical Schools.

The desire in France to associate instruction in manual or handicraft work with primary education has already been referred to in our first Report, and the causes which have led to this movement have operated in a similar way in French schools of a higher grade, in many of which manual work has been introduced with considerable success.

La Martinière School, Lyons.

The Martinière School at Lyons.—Of higher elementary schools, which are specially adapted to give a sound practical training to those who are to enter industrial or commercial life at a comparatively early age, the well known school of La Martinière, at Lyons, furnishes a typical example. We visited this school on the 19th, 20th, and 22nd of November 1881, and were present

during the teaching of several of the classes, and carefully examined the workshops, laboratories, and collections under the courteous guidance of M. Lang, the director.

Foundation. This school was founded 50 years ago by a bequest from Major-General Martin, who left Lyons a poor boy, fought against the English under Tippoo Sahib, and entered the service of the East India Company after Seringapatam had fallen. More than 20 years elapsed before the City of Lyons could recover his legacy from the Indian courts, and the school was at length established in 1830, on the remnant saved from the lawyers. The school was intended to give to the poorer classes of Lyons an education which should enable them to improve their position in after life. M. A. Monmartin thus sets forth the object which the founders of the Martinière had in view in creating this industrial school. "The intention of this school is to instruct the son of the work-"man, of the artizan, of the small manufacturer, or the tradesmen "of Lyons *gratuitously* in the sciences and arts applied to Objects "industry; to develope in him on the sole condition that he is "intelligent, moral, and industrious, those aptitudes which will "most surely conduct him to well-being, if not to fortune, and to "create new elements of productive force, and of future prosperity "to the country."*

Buildings. The school is housed in a large, but somewhat antiquated building (formerly an old convent of the Augustines) adapted and furnished at a cost of 40,000*l.* It contains good class-rooms, each capable of accommodating 80 pupils, a very large drawing room, in which all the pupils of the different divisions can work at once, workshops, laboratory, museum, library, council-room, director's office, &c., together with several dwelling-houses for the head master and other officials.

Administrative Commission. The school is presided over by an administrative commission, composed of seven members, who are nominated by the Minister of Agriculture and Commerce on the recommendation of the Municipality. The appointment is for seven years, and one member retires annually, but is eligible for re-election. The Mayor of Lyons is the ex-officio President of the Commission, and the trustee of the fund under the will of Major-General Martin, is the Vice-President. This committee appoints and dismisses the teachers, selecting them as far as possible from the old students of the school, but they must have completed their instruction as masters, and have obtained the diplomas of secondary teachers, and, for employment in some branches, of superior teachers.

Staff. A principal, a vice-principal, and five superintendents form the administrative staff, and the instruction is carried on under the care of 40 masters and 10 assistant teachers. These latter constitute a division of masters in training, and form an integral part of the organisation for teaching, as well as for disciplinary purposes. There is also a registrar and a chemical assistant.

* Precis sur l'École Martinière par. A. Monmartin, Lyons, 1862 (p. 6).

Conditions of admission.

The children are admitted to the school between the ages of 13 and 15, and in the month of October only, the preference being given to the sons of poor parents. The instruction is wholly gratuitous, no charge even being made for materials; the aim is kept in view of completing the course at an age at which the lads are still pliant and can readily adapt themselves to the special trade to which they may be apprenticed. The workshop instruction therefore is only carried to a point at which it is preparatory to after workshop training, thus permitting time for a more complete development of the theoretical studies of the pupils.

The number of boys is about 500. At the time of the Commissioners visit, these were divided as follows:—

1st year	-	273
2nd year	-	164
3rd year	-	62
		499

The course of Instruction.

The instruction comprises writing, arithmetic, algebra, geometry, kinematics, mechanics, book-keeping, commerical arithmetic, history and geography, study of the German and English languages, physics and chemistry, architectural and industrial drawing, and religion; the staple subjects being mathematics, physics, chemistry, and drawing. Under the present director attention has been given to the French language and literature, and an attempt has been made to establish a better balance between the literary and the scientific training. The course is one of three years.

Methods of teaching.

The system of instruction is peculiar, having a character of semi-military drill. Large classes of 70 or 80 boys are conducted by one teacher with the help of an assistant. The method has some resemblance to the mode of teaching mental arithmetic in this country. Questions are put to the class and answers are taken either orally from such scholars as the teacher may fix upon, or collectively on small slates or blackboards with which the scholars are provided, and on which the answers are written. These are collected by the assistant and quickly passed in review before the eyes of the teacher, who readily detects any errors which the boys may have made. In the teaching of arithmetic and algebra, a series of questions are given out on slips of paper, and the work is performed on one slate whilst the scholar is provided with a second slate on which he has to transcribe one or more answers arbitrarily chosen by the teacher; these "answering" slates are then collected and examined. This system certainly renders the boys quick and active-minded, but it is doubtful whether a system of so mechanical a character is capable of satisfactory application to any wide range of subjects.

Teaching of drawing.

The method of teaching drawing is not open to this criticism, and the results obtained in freehand as well as in mechanical

drawing in the three years appear to be highly satisfactory. This instruction is given to all the pupils in one large room about 140 feet × 45 feet, divided into sections by screens. The boys are arranged in circles round the object to be drawn, being seated on stools or "horses" with a back which can be inclined to any desired angle to support the slate or drawing board. At first the pupil draws on his slate only, to facilitate correction and avoid waste of paper; and the slate drawings of the pupils were found by the Commissioners to be excellent. Drawing from solids is insisted upon. The boys begin by copying from outline figures, squares, and circles constructed of stout wire. From this they pass to skeleton solids, and then to block-models of architecture. They then make drawings from parts of machines and scientific instruments; by this system they get a considerable power of neat and precise drawing. The Commissioners noticed on the walls of the room admirable diagrams prepared by the masters to show the way in which the models are to be drawn.

Modelling. All the boys are taught modelling in clay, to which they devote two hours per week.

Workshops. After inspecting the drawing room, the Commissioners visited the workshops, which they found to be indifferently fitted with apparatus. In one long narrow side-lighted room in which there were some 28 benches, the boys were engaged in planing boards, cutting mortices, &c. In a room leading out of this, there were about 36 lathes, and at these a class was at work turning cylinders, tool-handles, &c. A foreman instructor was in charge of each shop. All the boys in the school have practical work in the shop, in the first year for two hours per week, and in the second and third years for three hours per week.

Collection. There is a collection of machines which has been bequeathed to the school by one of its governors, M. Eynard, and this is receiving constant additions of models made in the workshops of the school.

Chemical laboratories. The chemical laboratory seemed poorly fitted considering the good results said to be achieved by the school. There are three masters for chemistry, of whom Professor Loir is the senior. The boys of the second year are divided into two classes of 70 each. The lectures are well illustrated by experiments performed by the professor, and the boys take excellent notes, with descriptive sketches. Only the third year boys do practical work, for which they have a laboratory containing 56 places, that is 14 benches with 4 working spaces on each bench. Five hours per week are devoted to chemistry. Most of the chief chemists of Lyons have received their early education in this school. In the teaching of chemistry, as indeed in all the other subjects, no text books are used.

Surveying. Surveying, including practical field work, is taught to all students of the second year.

Visits to works. The students visit factories and large works under the guidance of the masters, and on their return they have to write out full

descriptions of their visits. Under M. Lang's directorship this department of the school work has been encouraged and considerably extended.

School hours. The school hours are from 7 to 11 in the morning and from 1 to 7 in the afternoon. The school session is from October to June. The annual examinations then take place, and the prizes are distributed on the 1st of August. In addition to ordinary prizes the boys obtain money prizes, of amounts varying from 2*l.* to 6*l.*, in a book, showing that these sums have been placed to their credit in the local savings bank, 80*l.* per annum being set aside under the will of Gen. Martin for this latter purpose. There are also about 20 sums of the value of 2*l.* each, offered by friends of the school for the same purpose. The final examination is conducted by a competent board composed of engineers, manufacturers, &c.

Examinations and rewards.

Changes in the working. Certain changes in the working of the school have recently been instituted, to some of which reference has already been made. Of others we may mention the rule making the third year compulsory in order to obtain the leaving-certificate. The supplementary courses which occupied the third year and were formerly optional, and practically useless, have been re-organized, and the whole day occupied with school work. M. Lang has also consolidated certain of the courses, and has striven to give a continuity and systematic character to the training which had hitherto been wanting. Many pupils still leave at the end of the second year, but the number of boys staying for a third year is on the increase. In the first year of the experiment there were 49 third-year students, in the second year 49, in the third year 67, and in the fourth year 80.

Results. The Martinière boys are said usually to succeed well in the careers which they choose in after life. The principal dyers of the town are old pupils of the school. From 60 to 75 per cent. go into commercial houses, making good clerks and business assistants, and about 25 per cent. take up industrial pursuits. Some few of the Martinière pupils go to the École Centrale, Lyons.

Evening classes. In conjunction with the Martinière school there are also evening classes, attended by about 250 adults who receive instruction bearing on the local industries.

Old Students' Association. There is also an Old Students' Friendly Association, the aim of the members being to be mutually helpful to one another, and to aid their poorer comrades in the acquisition of a higher education.

The annual budget of the school is upwards of 4,000*l.*

For the programmes of the classes see Appendix 12, Vol. V.

Girls' School. *La Martinière School for Girls.*—In 1879 a girls' school was added to the organization of the Martinière, its object being to enable young girls of the working classes to fit themselves to fill remunerative situations on leaving the school. This forms at the same time a superior primary and a professional school. The girls on entry must have completed their 13th year. The school is

located at present on the seventh floor of a separate building, but at the time of our visit was about to enter newer and more commodious premises. The duration of study is three years and the general course embraces mathematics, physics, chemistry, drawing, grammar, history, geography, writing, and manual work. This general instruction is obligatory on all the pupils. The special instruction is given in three divisions (1) that of commercial knowledge; (2) that of industrial drawing (with special reference to designing patterns for lace, silk, and embroidery); and (3) that of dressmaking and fine needlework; and the girls may choose which of these sections they will take. The mornings are devoted to general studies, whilst in the afternoon the special instruction is given, and a quarter of an hour's interval for recreation is given after each lesson. In the drawing classes the pupils commence at once with drawing from models, and in addition to this practical instruction they receive lessons in the principles of ornament and design. When the new buildings are completed additional sections will be added for instruction in the making of artificial flowers and the arrangement of feathers. There are annual competitive examinations in the different branches of study, on the results of which prizes and savings-bank books are awarded. The course of instruction at this school appeared to the Commissioners to be excellently arranged and carried out.

M. Lang on the introduction of handicraft work into elementary schools.

In conversation, M. Lang expressed to the Commissioners his views concerning the question of technical education as carried out in France, more especially with regard to apprentice schools. He is strongly in favour of the introduction, even into the primary school, of a certain amount of handicraft work, yet he does not think that the establishment of special apprentice schools should be largely promoted. He conceives that the introduction of such manual instruction should be made only to the extent of giving boys a certain amount of readiness and aptitude in using their hands. He believes that these exercises not only give them this valuable power, but likewise greatly develope their faculties of observation. A general increase in this kind of manual instruction to more than three hours per week, he would deprecate, believing that the Municipality or the State is not called upon to furnish such instruction as qualifies for any one particular trade, but simply to go so far as that the knowledge gained may be applied to trades generally.

M. Lang is also the director of the Society for Professional Teaching in the Department of the Rhone, and has done much to arrange and systematize the evening instruction which is now largely given in Lyons (*see ante* p. 32, Evening Instruction).

Professional school of Rheims.

The *École Professionnelle Municipale* of Rheims is a school of a somewhat higher type than the foregoing, and is one of the best of the higher elementary schools which the Commissioners have seen. It was founded on the model of the schools of Mulhouse and Nantes, and differs from the Martinière school by the further development of manual labour in the shops.

Object of the school.

The school was established in 1875, in order to impart to the youths of the city of Rheims special practical knowledge of manufactures, and to train them early to satisfy the requirements of her trade and commerce. A municipal commission composed of city councillors, leading manufacturers, and tradesmen of the district, came to the conclusion that professional education ought properly to be the continuation and the normal development of primary education, and that such a school as this should draw its pupils from those children of the elementary schools who had passed a satisfactory examination.

The school thus established is housed in a handsome modern building erected at a cost of 24,000*l.*, and admirably adapted in every way for its intended purpose. In the Appendix, Vol. V., will be found a series of plans, together with the front elevation of this building and the programme of the classes. The director of the school is M. L. Pillods. The instruction, so far as it is not technical, is about parallel with that of the École Turgot in Paris.

There is an entrance examination for those who do not possess the leaving certificate of the primary school. This examination includes a knowledge of the rules of grammar and their application; dictation (not more than five mistakes); arithmetical problems, including vulgar and decimal fractions and the metric system.

The boys enter the school at about the age of 13, and the course of study extends over three years. During the first two years, all the pupils pass through the same course of theoretical and practical instruction, and the course up to this point serves also as a preparation for the École des Arts et Métiers at Chalons. Very few boys leave at the end of the second year. There is an examination at the end of each year to determine the promotion to the superior division.

The third year boys are divided into sections according to the aptitude displayed by them during the initial study period, and they are classified according to the different industrial and commercial pursuits carried on in Rheims and the neighbourhood, as follows:—

Classification of pupils.

1. *Manufactures.* The woollen manufacture being the chief one, the various modes of sorting wool, the carding, the spinning, and the weaving, claim special attention.

2. *Mechanics.* In every important combing, spinning, or weaving mill are shops for the repair of the machines and looms; without taking into account the many mechanical engineering establishments of the district.

3. *Commerce.* The trade in raw materials, manufactured articles, champagne, &c., gives rise to a commerce amounting to several millions of francs annually.

4. *Agriculture.* The important results recently attained in agriculture on the poor arenaceous soil of the champagne country, and the results still to be achieved, gave the idea of adding an agricultural section to train the young men of Rheims.

In order, moreover, in the brief space of three years to train up these boys so as to be capable of rendering real service on quitting

the school, it has been found necessary to enable them to supplement their theoretical studies with practical work analogous to that which they will have to practise in their future profession, and to place at their disposal a complete and well organized plant for this purpose. Rheims has spent 16,000*l.* to 20,000*l.* on this plant, and has thus placed her schools in the first rank of similar institutions.

The workshops and laboratories are large, airy, and well-lighted:—

Weaving and spinning.

The weaving and spinning sheds contain a carding engine, a drawing frame, a spinning frame with 40 spindles, a warping machine, nine small pattern weaving looms, four jacquard looms, a punching and card-cutting machine, and four power looms, each of a different type, and of the most recent construction. In this department the student is able practically to apply his theoretical instruction to the production of the various textile manufactures of Rheims. He can, in fact, spin and weave the wool he has himself washed, carded, dyed, and prepared, and can moreover practise each operation in the school with similar plant to that which he would find in the regular factory. This department is provided with a large collection of woven fabrics and samples of raw materials.

Engineering shop.

The fitting shop is provided with a 10 h.p. engine, 4 forges, three lathes, a screw cutting lathe, a planing machine, a drilling machine, three slotting machines, and 52 vices. For wood-working, there are 20 carpenters' benches, five lathes, and a band-saw frame.

Mechanical drawing.

Drawing is taught by the master who teaches engineering, on a plan which is novel, and produces very good results. This instruction is given in the workshops, and will be most conveniently described here:—

Method of teaching drawing.

The students in the first year spend three months in drawing from sketches on the black-board; they then proceed to make freehand sketches of geometrical solids, tools, and parts of machines. These sketches are afterwards carefully figured, for dimensions, and from them accurate drawings to scale are prepared. Finally, they produce in the same way freehand sketches and finished drawings of the objects that they actually make in the workshop. By this system, the students of the second year become rapid and ready draughtsmen, having devoted seven hours per week to drawing, whilst in the workshop they have spent six hours per week (two hours per alternate day), and have thus learnt the value of drawing, of mechanics and of geometry, by seeing their application at every step. In the third year, the students spend 18 hours per week in practical shop work.

Chemical laboratories.

The two *chemical laboratories* are excellently planned and fitted. One of them has accommodation for 80 students, and here the first and second years' students go through a course of practical inorganic chemistry. The first year students give only one hour per week to chemistry, whilst in the second year they have two lessons per week of one and a half hours each. So well chosen are the experiments, and so simple is the apparatus, that the whole cost of 200 experiments

Practical chemistry.

carried on by each student of the first and second year does not exceed a sum of five francs per head per annum. The third year students, who are in training for chemical industries, have a special laboratory reserved for them with accommodation for 40 pupils. In this laboratory, attention is devoted to the chemistry of dyeing. About half the students learn dyeing in the third year. There is also a good lecture theatre capable of seating 200, and a room containing a large collection of chemical preparations. The chemical master, M. Réné Leblanc, showed the Commissioners some sets of simple apparatus which he had arranged for teaching chemistry in primary schools; the larger set costing 2*l.* 8*s.* (60 francs) in a box complete, and the smaller set, 1*l.* 4*s.* (30 francs). He has written also some primers on chemistry and physics for the illustration of which this apparatus is suitable.*

Physical laboratory.

The *physical laboratory* is well arranged and complete, and contains numerous instruments and appliances for teaching mechanics, levelling, surveying, meteorology, and agriculture.

School museum.

There is also an admirable school museum, containing physical and other scientific apparatus, and a collection of the works and preparations of the pupils.

The school hours are from 7 to 12 in the morning and from 1.30 to 7.30 in the afternoon. The holidays are a fortnight at Easter and six weeks in the summer.

Fees, &c.

The pupils pay 10 francs per month (that is 4*l.* for the school year of ten months), a fee which brings the school well within the means of the lower middle classes. Most of the pupils are, indeed, sons of foremen and small tradespeople, or people of the operative classes. There are 160 pupils, of whom 22 hold municipal exhibitions. There is an unlimited number of free studentships.

Number of pupils.

At the time of the Commissioners' visit there were 37 boarders lodged in a separate building. These pay 26*l.* per annum, in addition to the school fee of 4*l.* It was stated that the number of boarders would shortly be doubled.

The school has quadrupled its number of students since its foundation in 1875, and the number of boarders would be largely increased if sufficient funds were available to defray the cost of another boarding-house. This school received the gold medal at the Exhibition of 1878.

School budget.

The budget of the school is upwards of 2,400*l.* per annum, and the average receipts from fees 560*l.* The school has at present no Government grant, but receives 240*l.* from the town of Rheims and 160*l.* from the Department. The budget details will be found in Appendix 13, Vol. V.

A fair number of the pupils who have completed their education here have been drafted off into the industries of the district, and it is said that on leaving the school they at once earn three to four pounds per month.

* The apparatus can be bought from M. Laiseu, Rue Fontaine au Roi, 57, Paris.

Since the time of the Commissioners' visit, and in accordance with the law on primary and higher elementary education, the school has been adopted as a National School and it will be enlarged and made still more effective. It will also become gratuitous. The school will in future receive 40 Government exhibitioners. The changes effected by the new law will, it is believed by the school authorities, be beneficial; indeed they were petitioned for by the town. It is quite understood and agreed that the school will preserve its autonomy as regards its programme.

Rouen professional school.

The *École Professionnelle Municipale* of Rouen, is another school, much of the same type as the foregoing, but in which more attention is paid to mechanical industries. This school, which was also visited by the Commissioners, was founded in 1853. The director is M. Delarue. The special object of the instruction is to prepare youths to enter the Écoles des Arts et Métiers, but a certain number of the pupils leave the school to enter at once into practical work. The bulk of the pupils are the sons of the small tradespeople of the town; some of them enter with scholarships given by the Government, or by the municipal authorities. There are six exhibitions given by the city of Rouen, 12 by the Department, and four by the State. The education at this school became gratuitous under the law of July 1881. The school expenses, hitherto paid by the town, have amounted to about 1,120*l.* annually. The school course, which combines both theory and practice, extends over three years, and is conducted in very indifferent premises. The boys must be at least 12 years old on admission, and must have the amount of knowledge necessary for the primary school certificate. Prizes and medals are given to deserving pupils at the end of each year. Frequent visits are paid to works and factories. There is a chemical laboratory, but the instruction in this subject seems to be inferior to that of the Rheims school. Instruction in the English language is given to all the pupils. There are about 140 students, half of whom are boarders, and there is a preparatory course for the younger boys. The hours of theoretical study are from 7 in the morning till 6 at night, with three hours of recreation, and in the evening two hours of manual work. They therefore have eight hours of class work and two hours of manual work per diem. The practical instruction consists of working in wood and iron. The handicraft work is carried on in a large room lighted from the top, having desks for drawing down the centre and working benches against the walls; all the pupils work in this room at the same time. The pupils are put through a graduated series of manipulations; for example, in smiths' work and turning of iron, each pupil has to make in succession every one of the hand-tools mentioned in a list and figured on a table hung up in the workshop. The boarders pay from 24*l.* to 26*l.* per annum. Many of the pupils, after having passed through the school, ultimately obtain situations as foremen; others enter the Government schools of Châlons or Angers. At a recent exami-

Workshop instruction.

nation, 10 pupils from this school presented themselves for the entrance examination for Châlons, and 9 were admitted, being one-eleventh of the total admissions for the year. This fact was quoted to prove that the school is a good one.

Object of the instruction.

The director stated that the object of the education was not to form foremen, but rather to give a general education, calculated to serve as the basis for many trades. He pointed out a school museum containing specimens of various products for object lessons, and stated that similar museums were about to be formed in all primary and higher elementary schools in France. Amongst the specimens, the Commissioners noticed a Prussian soldier's helmet. On being asked why it was placed there, the director stated that it was picked up during the German invasion, and added that it was his custom to point out to his scholars that France lost her best provinces through the superior education of the invaders, and the helmet served as a constant warning and stimulus to the students.

Superior professional school, Rouen.

A second and somewhat higher school in Rouen is the *École Supérieure du Commerce et de l'Industrie.* This school was originally founded by a private society established for the "development of the industries of Normandy," and has since been transferred to the municipality. It is divided into a commercial section, and one for weaving and dyeing. It is supported partly by the town and partly by the State; the Chamber of Commerce also contributes towards the expenses. There are 40 students, none of them being boarders. To show the extent to which scientific instruction is applied to the industries of the district, it may be here remarked that M. Permethier gives a complete course of instruction on the microscopic examination of the various textile fibres and tissues, and that this school obtained a gold medal at the Paris Exhibition of 1878 for its researches. A notice of the weaving department of the École du Commerce will be found among Section IV.

Amiens professional school.

École Primaire Supérieure, Amiens.—Another school of a somewhat similar type visited by the Commissioners is the Superior Primary School of Amiens. The principal is M. Dufrenoy.

This school was established by the Municipality of Amiens three years ago, and now contains 110 pupils. They are received at 12 years of age by competitive examination from the primary schools of the town. The object of this school is not to form apprentices, though practical work is introduced to the amount of three hours per week. Drawing is taught largely, both freehand and mechanical. The course consists of three years, the first year being divided into two groups. Each pupil pays 10 francs per month, but exhibitions are given to all who require them. It is the intention of the municipal council to buy land and build a large school, with appropriate workshops.

The pupils on leaving the school obtain work on the railways, in the service of the Ponts et Chaussées, &c. One pupil sent to the Châlons school stood first in the entrance competitive examination for that school.

Education vote in Amiens.

The principal handed in a budget of the city of Amiens, in which the whole of the expenses of the school, as well as of the other schools of the city, is contained. He stated that the town of Amiens, with 66,896 inhabitants, spends probably more in education than any other town of the same size in France, the vote amounting to 16,000*l.*

M. Dufrenoy was well acquainted with many of the other schools of a similar kind in France, and expressed an opinion adverse to the system of education adopted at the Martinière at Lyons, speaking of this as a system of mechanical drill rather than one of great educational value.

Mulhouse Professional School.

École Professionnelle, Mulhouse.—This school is described here rather than amongst the German schools, because it was founded in 1854, prior to the annexation of Alsace to Germany, and is similar in constitution to some of the French schools already described, but of a somewhat higher grade. It is intended for the training of the sons of small manufacturers and of persons in easy circumstances. It occupies convenient and well arranged buildings in the outskirts of the town. The director is Dr. Cherbuliez. The school contains about 250 pupils. It is principally a day school, but has a boarding house attached with about 40 boys. The school fees range from 4*l.* in the four lower classes to 5*l.* per annum in the higher and industrial classes. The boarders pay 32*l.* per annum. For the workshop the boys pay additional fees, namely, 1*l.* 4*s.* in the joiners' shop and 2*l.* in the machine shop. The ages of the pupils vary from 9 to 18. There are 22 masters, including the instructors in the joiners' shop and the machine shop. This school is described as one nearly equal in rank to the French Lycée, but differing from it in the substitution of English and French for the classical languages. It is necessary to pass a simple examination on entrance.

Course of instruction.

The course of instruction is the same for all the pupils until the age of 14 is reached, when a bifurcation takes place: some boys enter the commercial section, and stay two years; others, the industrial section, and stay four years. In this latter section they are taught history, literature, mathematics, the physical and mechanical sciences, and drawing, and as special courses machine construction, textile fabrics, and the chemical arts. Summer excursions, entirely at the cost of the school, and frequent visits to manufactories, are important features in this school. Thus during the year 1879 visits were paid to a carpet factory, a paper mill, two machine works, two spinning mills, a dye-works, and two tool manufactories, and opportunities were given to the pupils to obtain a full insight into the industries of the district. The two highest classes work six hours per week in the shops, the four lower classes four hours. The shops

Practical work.

which stand on either side of the open court or playground are spacious and well supplied with tools. The joiners' shop contains about 30 benches and five lathes, and the mechanics' shop has 30 vices.

Results of workshop instruction.

The practical teaching in this school is said to have been productive of excellent results. The Commissioners were shown some first-rate models in wood of parts of machinery, pedestals, brackets, &c., made by the boys, also a large stock of mechanical work done in the fitters' shop. The workshop instruction is not designed to teach trades, but is intended to give the lads a fair proficiency in the use of tools, and a good knowledge of mechanical operations. The drawings shown to us were very good, and large, carefully finished drawings of machinery, being made from actual measurement. There is a well-fitted chemical laboratory in which the upper classes do two hours of practical work per week.

The budget of the school for the year 1877 was as follows:—

	£
Receipts—	
School fees - - -	2,212
Subventions from State and towns	2,488
Total - -	4,700
	£
Expenditure—	
Salaries - - -	3,038
Boarding house .. -	1,112
School expenses - -	470
	80
	£4,700

(3.) Higher Elementary Technical Schools in Germany.

Absence of schools of this type in certain countries.

The Commissioners have not found in Germany any schools which exactly correspond to the professional schools of France, already described. There have existed, however, since 1850, a number of schools known as Gewerbe Schulen (trade schools), originally intended to impart technical instruction to boys in training to become masters of small industries, foremen in works, &c. In these schools primary education is continued, and additional instruction is given in mathematics, descriptive geometry, drawing, elementary science, and some modern language. In none of these schools is any attempt made to give workshop instruction. In most parts of Germany these schools are now known as Lower Real-schulen and lead up to the Industrial School of Bavaria, or the Higher Secondary Real School in other countries. The Commissioners visited schools of this type at Munich, Stuttgart, and Berlin. *See* Appendix 8, Vol. V.

(4.) Higher Elementary Technical Schools in Austria.

State Trade School of Reichenberg.—In Austria, where, as we have already shown, there is a movement in favour of teaching practical work in schools, and of the establishment of *Fach Schulen*, we find in the *Staats Gewerbe Schulen*, with workshops attached, schools of a type somewhat similar to the French schools.

We have selected the school of Reichenberg as a good illustration of a somewhat numerous class of similar establishments. This school consists of two divisions, (*a.*) the higher trade school, and (*b.*) the foreman's school. Each of these divisions has the three departments of building trades, mechanical, and chemical technology. Higher Trade school of Reichenberg.

(*a.*) The higher trade school gives in its first department the necessary theoretical and practical instruction for builders, contractors, carpenters, and persons engaged in other branches of the building trade. The second department is for the training of those who are likely to be employed as foremen or superintendents in workshops and factories of all kinds; and the third department is destined to train foremen and others for chemical industries, sugar works, wax factories, and dye works, a special laboratory being provided for dyeing. The instruction extends over a course of four years. The students are admitted on presentation of the leaving certificate from the *Bürger Schule* or of a corresponding class in the *Real Schule*, the *Real Gymnasium*, or the *Gymnasium*, and a knowledge of drawing is indispensable. The students pay 1*l.* 3*s.* 4*d.* (14 gulden) per annum, and in the chemical division 1*l.* 13*s.* 4*d.* (20 gulden). The first year's course, embracing German, mathematics, drawing, physics, and chemistry, is common to all departments. In the second year certain subjects only have to be taken by the students of all the divisions, special instruction being given at the same time to the pupils in the separate departments. The specialisation is carried out more and more fully as the student advances in the course. Whilst the instruction is of a practical nature, embracing laboratory teaching and modelling, there is no obligatory workshop instruction proper. Optional instruction is given in stone cutting and modelling, to students in the building trades' section. Division for builders.

(*b.*) The school for foremen is especially arranged for those who have already become acquainted with the practical details of their trade, and is intended to familiarize them with the theoretical parts of their work. This portion of the school is attended therefore mainly by adults. It is divided into the same three departments as the higher trade school. The course extends over four half-years, which is a continuous two years course for the mechanical and chemical departments, whilst the instruction in the building trades' school is only given in the winter, in order to enable the students to follow their ordinary occupations in the summer. The conditions of entrance are Division for foremen.

merely that the students shall have passed through the ordinary elementary school and have occupied two years in practically working at their special trade. The payment is 16*s.* 8*d.* (10 guldens) for the half-year in the chemical department, and 10*s.* (6 guldens) in each of the two others, but pupils in poor circumstances can be received without payment. The subjects of instruction are very similar to those in an ordinary elementary school, with the addition of chemistry, physics, and mechanics, taught both theoretically, and in their application to the special trades.

General Review of Continental Higher Elementary Technical Schools.

General review of Higher Elementary Technical Schools.

The class of schools above described, of which the best examples are found in France, form a special feature in the system of technical education abroad. It will be seen from the preceding descriptions, that in these intermediate schools children of artizans and of small shopkeepers have opportunities of obtaining an education which is technical, in so far as their studies are specially directed towards the requirements of commerce, mechanical, or manufacturing industry. Mathematics, science, and drawing, constitute the main subjects of instruction; and in nearly all the modern French schools, of which that at Rheims may be taken as the best type, the laboratories for the teaching of practical chemistry leave little or nothing to be desired. In these schools the workshop instruction is carried to a much more advanced stage than is possible or desirable in the elementary schools, and there are special departments replete with models, apparatus, and specimens for teaching the technology of the trades which form the staple industries of the district in which these schools are situated. *The classical languages do not enter into the curriculum of any of these schools.* The time thus saved is devoted to mathematics and to modern languages. Schools of this kind are singularly wanting in our own country. Perhaps the best example of a school similar in character to the higher elementary or technical schools of France, is the Allan Glen's Institution at Glasgow, a notice of which is found in another part of our Report.

By the law recently passed in France, education in these higher grade French schools is rendered gratuitous, and numerous bursaries are given to select pupils entering them from the elementary schools. In the German trade schools the fees are exceedingly low. In the whole system of French instruction your Commissioners have found nothing, except as respects art teaching, which seems to them to be so worthy of attention with a view to their adaptation to the special requirements of this country as these higher elementary technical schools.

B.—Secondary Technical Schools.

We now pass on to a series of schools of a higher grade than those we have just been describing, which serve mainly as finishing schools for those who are to occupy intermediate positions in industrial concerns, but from which in many cases the more promising students proceed to complete their education in the schools or institutions for higher technical education existing in the country. Schools of this type are found in most of the countries visited by us. In some of them, as in Italy, and in parts of Germany, they occupy a definite position in the school system of the country. Secondary technical schools.

In Bavaria, under the name of Industrieschulen, they take a distinct rank between the Real Schulen and the Polytechnic.

(1.) Secondary Technical Schools in France.

The École Centrale of Lyons is a school for the training of mechanical engineers, which may be regarded as one intermediate in rank between the Écoles professionnelles and the École Centrale of Paris, or the Polytechnic Schools of Germany. More time is devoted to theoretical instruction than in the former schools, while practical instruction is given here, and not in the École Centrale of Paris; and the students leave this school at the age of 19 or 20, whereas the students leaving the École Centrale of Paris and the German Polytechnics are invariably considerably older. The object of the school is to train managers and superior foremen. The school is mainly supported by the fees of the students, and scholarships are granted by the Chamber of Commerce and the Municipal Council of Lyons, as well as by the General Council of the Department. The students are not boarders; they are not admitted till they are 16 years of age, nor without having passed a mathematical examination. Many of them come from the École Martinière. Lyons Engineering School.

The instruction embraces mathematics and physical science, which are carried up to, but not beyond, the point necessary for their practical application. Thus, we found certain of the students working out practical problems on the blackboard, by means of the differential and integral calculus. In the opinion of the director, M. G. Fortier, the instruction in this school is of a more useful character than that at Châlons, *see* p. 107, or at the École Centrale at Paris, inasmuch as at Châlons there is too little manual work to turn out efficient workmen, and too little instruction in the principles of science for the training of efficient managers, whilst at Paris the reverse is the case; there no instruction in practical work is given, and consequently the students, on leaving the school, find themselves considerably embarrassed when required to superintend workmen in a large shop. Nature of the instruction.

School of chemistry: dyeing.

Besides the school for mechanical engineering, arrangements were at the time of our visit approaching completion for establishing a school of applied chemistry, with special reference to dyeing, an industry of considerable importance in this district.

Mechanical workshops.

The school has a very well fitted workshop, about 40 ft. by 30 ft., containing a steam engine, planing, drilling, and slotting machines, two lathes, and nine vices; the cost of the machinery was 880*l.*; besides this there is a smaller workshop for elementary work in carpentry, joinery, and turning, principally in wood, with places for 21 students; there are several good rooms in which mechanical drawing is taught; the pupils learning to make drawings to scale, either from models, of which there is a very good collection in the school, or from sketches. There were excellent collections of mechanical and physical apparatus, much of which was made by the students themselves.

Laboratories

The laboratories were not less complete. There was a general laboratory for first year's students, and a smaller laboratory, specially fitted up for instruction in dyeing, containing a centrifugal wringing machine (hydro-extractor) and steam pans for dyeing purposes, steam closets, &c. All students of the third year go through the dyeing laboratory. The students attend from 8 to 12 and from 2 to 5 every day.

Number of students. Fees, &c.

The number of students in this school is, however, but small, amounting only to 55. The students work 1½ hours daily in the shops under a master workman, and once a fortnight visit factories in the neighbourhood, in groups of three or four. The fees amount to 28*l.* per annum. The Chamber of Commerce contributes 60*l.* per annum, the Municipal Council 112*l.*, and the Department 112*l.* There are 12 bursaries to be competed for by the students.

The director informed the Commissioners that the pupils from this school readily find places in industrial works, and obtain posts worth 80*l.* per year.

The Commissioners are of opinion that schools of this kind, in which the education is not of too theoretical a character and is adapted to the special industries of the district, might with advantage be introduced (with the necessary modifications) into many of the large manufacturing towns of this country, or added as a special department to several of the colleges recently erected, or now in course of erection, in the United Kingdom.

Institut Industriel of Lille.

The Institut Industriel du Nord is housed in a fine new building in the Rue Jeanne D'Arc, at Lille. The director is M. Masquelez. It was founded and is maintained by the Departement du Nord and the city of Lille, and it also receives a subvention from the State. It comprises two distinct schools, the Industrial School and the Agricultural School.

Objects.

The instruction in the *Industrial School* has for its object the formation of managers and directors of works for the chief industries of the north of France, especially for the sons of persons engaged in industry; that in the *Agricultural School* is for the

purpose of giving the necessary scientific knowledge to the sons of the landed gentry and gentlemen farmers, and includes the so-called agricultural industries, such as the sugar manufacture and distilling. The teaching is both theoretical and practical, and comprises, in addition to lectures and drawing lessons, practical chemical work, mechanical work in the workshops, and visits on an extended scale to industrial establishments.

Date of foundation.

The institution was founded in 1872, but has since then been accommodated in the new buildings, which are of a very complete and elaborate character, at a cost of 40,000*l.*; these include the residence of the director, the laboratories, of which there are three (one for general chemistry, one for analytical chemistry, and one for industrial chemistry, especially for dyeing), and mechanics' and joiners' shops, which are well furnished with the necessary machines and materials.

Division of school.

The Industrial School is in two divisions, viz., (*a*) the technical, in which the teaching is more especially adapted to foremen, and (*b*) that of civil engineering, the teaching in which is of a higher grade. The course of each division, as well as in the Agricultural School, is for three years.

The lower division is again sub-divided into three sections:—

(1.) Mechanical engineering,
(2.) Textiles,
(3.) Chemical industry;

whilst the so-called civil engineering school is divided into four sub-sections:—

(1.) Machine construction,
(2.) Mining and metallurgy,
(3.) Textiles,
(4.) Chemical industry.

A detailed syllabus will be found in Appendix .

Diplomas are given to students, on examination, at the end of their third year, after which they are allowed to assume the title of civil engineer.

Fees.

The Lille Institute is only a day school, but there is a boarding house connected with the establishment for 35 boarders, each of whom pays 24*l.* per annum. The fees of the institution are 16*l.* and extras amount to about 8*l.* At the time of our visit there were 115 pupils, of whom the larger proportion were engineering students. The total annual expenses amounted to 3,280*l.*, made up as follows:—

	£
Students fees - - - -	2,080
Subvention from the Department -	840
„ Town - - -	280
„ State - -	80
	3,280

Staff.

For the purpose of teaching the large number of subjects specified on the programme, a numerous staff of professors is requisite. Thus there are 29 professors and 10 foremen and other assistants, the sum paid to the teachers amounting to 2,300*l.*

The school is governed by an administrative council, consisting of four of the Town Councillors, presided over by the Mayor. There is also a committee of inspection for regulating the courses of study.

Equipment of workshops.

The Commissioners found the workshops supplied with English and other machinery both for spinning and weaving, which constitute the main industries of the neighbourhood. There is also a good machine shop fitted with lathes, vices, forges, &c. We noticed that the laboratories were in active work, several students occupying themselves practically with the chemistry of dyeing. We were much impressed with the system of teaching

Drawing.

drawing. In the first year the students work from copies, after which they make measured drawings of parts of machinery. In the second year they take up descriptive geometry, projection, and perspective; also projection of shadows, first of plane figures and then of curved and moulded figures, with the shadow lines carefully indicated; then machine drawing, gearing, with projection of shadows of wheels and parts of machinery; then plans and sections of actual work and of objects they have made in the shop, with tinting and shading. In the third year they take gearing and mill work, and kinematics. There is a very complete architectural course. The collection of models was very good.

Farm.

An agricultural farm of about 27 acres is attached to the school, but the number of students in this division is very small, amounting only to eight. There is a well stocked museum of agricultural products.

The plans of this school will be found in the Appendix, Vol. V.

Objects and aims of the Lille Institute.

The main object of this school is not to form superior workmen or foremen in mechanical shops, as is the case in the Châlons school which will be hereafter described, but engineers and works' managers, and the theoretical instruction is therefore of a higher character than in workmen's schools, and less time is devoted to mechanical work in the shops than would be necessary to turn out finished workmen. The director of the school seemed desirous to raise the character of the teaching so as to attract the same class of students who go to the École Centrale of Paris, but who require a more practical instruction than that school affords. The opportunities which the school presents for practical chemical work, especially in its application to dyeing, were excellent, but the Commissioners were not equally impressed with the value of the teaching in the textile department, where many of the machines were of an antiquated type, and were apparently little used by the students.

Too much is being attempted.

On the whole, we thought that the school was aiming at too much, and that the lower department was being neglected to

some extent with the view of filling the classes for higher instruction. It must be remembered, however, that the establishment is comparatively new, and that the value of its teaching, as well as of its influence on the numerous flourishing industries of the district, may be better estimated in a few years hence.

Additional school in contemplation.

As indicating the importance which the French Government attaches to technical instruction, it may be well here to mention that in addition to the foregoing institution it is contemplated to erect in Lille a fourth school of the type existing at Châlons, Aix, and Angers, for the complete education of superior workmen and foremen.

(2.) Secondary Technical Schools in Switzerland.

Technicum, Winterthur.

The Technicum or Technical Institution of Winterthur must also be placed among schools of the foregoing category. This school is unique of its kind, and has for its special object the training of foremen. Except as to the work done in the chemical laboratory, the teaching is mainly theoretical; the students being expected to have passed some time in practical work before coming to the school.

School building.

The school, of which Herr Langsdorf is the director, is housed in a well constructed and beautiful building which was erected by the town at a cost of 40,000*l.* In connection with it, situated in a building at the rear, is an excellent Industrial Museum, with good collections of machinery and trade products, consisting of furniture, pottery, and local manufactures. The institution receives a grant from the town of 600*l.* a year; the fees of the students amount to 480*l.*, and the Canton of Zurich supplies the annual deficit by a grant of about 3,200*l.* The school comprises six different departments, attended by 165 pupils. The following is a list of the various divisions:—

School divisions.

1. Mechanical engineering.
2. Building construction.
3. Chemistry.
4. Land surveying and civil engineering.
5. Commerce.
6. Industrial art and decoration.

Programme.

The school courses underwent considerable modifications in 1882. As then arranged, in the architectural, the engineering, and the land surveying divisions, the instruction extends over five terms or semesters. In the three remaining departments the complete course comprises four semesters.

Fees.

The students pay 2*l.* 8*s.* per annum, and those who attend the chemical laboratory pay an additional fee of 1*l.* 12*s.* The class rooms are spacious and well furnished. The chemical laboratory under the direction of Dr. A. Rossel occupies a separate building, with preparation and lecture rooms, dyeing room, a small room for photometric experiments, &c.

There is a preliminary examination for the new students at the commencement of each half-year.

Ages of students.

Many of the students come here after having been practically engaged in some industry; the ages therefore vary considerably. The director prefers to take lads who have left school at 15 and have subsequently spent two or three years in actual work. The students must go through the whole of the prescribed curriculum of any one department. The instruction given in this school is not very advanced, as will be seen from the programme (Appendix 14, Vol. V.), and it is doubtful whether the experiment can be considered successful. Too much appears to be attempted in too short a time.

(3) Secondary Technical Schools in Germany.

Chemnitz Higher Trade Institute.

Higher Trade Institute of Chemnitz, Saxony.—The educational system of Saxony, especially in its technical bearings, is one of the most complete and well organised to be found in Germany, and the Commissioners devoted some considerable time to an examination of the various schools in the town of Chemnitz, where we were received by the burgomaster, Dr. André, to whom we are indebted for a large amount of valuable statistical and other information respecting the education of the town. Attention has recently been particularly directed to this subject by a work entitled "Technical Education in a Saxon Town," by Mr. H. M. Felkin, of Chemnitz, published by Messrs. Kegan, Paul, & Co., for the City and Guilds of London Institute for the Advancement of Technical Education. The work contains full detailed plans and descriptions of all the chief educational establishments of the town, and amongst others of the one we are now about to describe. This important institution, which was visited by the Commissioners, is supported and endowed by the Saxon Government; it is, strictly speaking, an aggregate of technical schools, and is one of the largest in Saxony and central Germany. The schools consist of two massive buildings, each four storeys high, with two wings running to the back on either side, containing the general school, with the foremen's and building schools. The chemical laboratory, at the back, is also a four-storey building, running parallel to the main one, and containing the chemical, technological, and physical departments.

The cost of the building, which was completed in 1877, was as follows:—

	£
The land - - -	14,700
The main building - -	42,521
The laboratory - -	20,019
The chimney and boilers -	4,703
	£81,943

The building contains 130 rooms, having an area of 8,890 sq. metres, excluding staircases and passages.

This institution comprises the following four schools:— Institute consists of four divisions.

(A.)	A Higher Technical School with	181	students.*	
(B.)	„ Foremen's School „	152	„	
(C.)	„ Building School „	119	„	
(D.)	„ Drawing School „	129	„	
		581	„	

The staff consists of the director, Professor G. Wunder, 12 professors, and 28 teachers in the various departments, besides laboratory assistants, 12 clerks, &c. Staff.

This is not a boarding school; the pupils live at their own homes, and they are only under the supervision of the director and masters during school hours.

(A.) *The Higher Technical School.*—According to the calling that the pupils may have chosen, the instruction is given in three divisions:— The Higher Technical School.

(1.) The technical-mechanical school for future manufacturers and technical managers for the various branches of the machine-building, spinning, weaving, and other similar industries.

(2.) The technical-chemical school for the same class of persons in the various chemical industries.

(3.) The architectural school for future architects.

Instruction in general science and languages is given to pupils of all the three divisions together. On the other hand, in those subjects which take a particular direction and lead to special industries, it is given only in that one division. Thus, the instruction in the first course is for all the students, whilst in the second and third courses the students are divided according to their future callings. The first course of all the three divisions comprises three half-years, and the second course of all the three divisions two half-years; the third course of the two first divisions comprises two half-years, whilst the third course for architects comprises one half-year. Nature of the teaching.

An important condition for entry into the architectural division is that the students, after their first year, must have spent one summer half-year in practical work in some building occupation, and also have done the same for half-a-year before entering. Practical work.

The whole course for each division, therefore, requires from 3½ to 4½ years. Pupils must be at least 15 years of age, and must have the sanction of their parents or guardians. It is a general rule that, if any student, after remaining in any course for twice the usual time, is still unfitted for entering the next higher course, he must leave the school. The fee in all the divisions and courses is alike, namely, 3*l.* the half-year, and the cost of books and Duration of courses; fees and scholarship.

* In May 1882.

drawing materials amounts to from 2*l.* to 2*l.* 10*s.* per annum. Deserving pupils, without sufficient means, can obtain a remission of the fees. In 1881–2, 18 pupils had their fees entirely remitted, and three students received scholarships from the Minister of the Interior for the entire year.

Excellence of the teaching.

The Commissioners were much impressed with the thorough character of the work done in this school, and with the completeness and extent of the apparatus and models for teaching. The method adopted by Prof. Weinholdt, whose work on the practical teaching of physics is well known, appears extremely good, and the results have been markedly successful.

Ages of students.

In the Higher Technical School most of the pupils remain through the three courses, until they have obtained the certificate, which is given after due examination. They do not generally enter the school till they are 16 to 17 years old, for, until that age, they have not finished at the Gymnasium or Real school, and as they remain for 3½ to 4½ years this brings them to about 21; their military duty has then to be performed, their school certificate entitling them to exemption for two out of the three years obligatory service, and afterwards they enter into active life.

The Architectural division has for its object to educate architects for ordinary buildings, and not to compete with the Architectural Academy of Dresden, which is the school for Government architects, and, generally, those of a higher order.

Royal school for Foremen.

(B.) *The Royal School for Foremen* has for its object to give the opportunity of obtaining the theoretical knowledge required in their future career to persons about to be machinists, millers, dyers, bleachers, tanners, brewers, manufacturers of soap, sugar, chemicals, &c., as well as to young men intending to be foremen and managers in mills and machine shops. The instruction in this school is comprised in three continuous courses of half a year each, making a total of 1½ years, and in this time the pupils are only able to acquire what is practically necessary for their technical occupations, and the course has not the object of giving an extended scientific culture. There are two divisions; one for machinists and one for chemical workers; and some general subjects, such as freehand drawing, the German language, and book-keeping are also taught.

Conditions of admission.

The pupils entering must be 16 years of age, and sufficiently educated to read, write, and work out the four rules of arithmetic. They give their whole time to the school, and have also work at home. The fees amount to 30*s.* for each course, besides 15*s.* for materials. "It is a condition that each pupil shall have worked two years at his occupation before entering, and this regulation gives the key-note to the idea which led to its foundation, namely, to give the necessary theoretical knowledge to capable, industrious young workmen, so as to enable them to become foremen, and, perhaps, practical managers. It therefore provides the necessary link, enabling a young man who has it in himself to a higher position, and is intended

to keep the industries of the district well supplied with a class of men between the common workmen and the masters, a necessity which is much felt in Saxony, as the workmen there are said to require much supervision and direction." The courses of instruction in this school are strictly distinct from those in the higher technical school, being given in separate class-rooms; and the school has its own collections of machinery and models, scientific instruments and apparatus. The pupils are, socially, of a class quite different from those attending the higher technical school, and do not come into contact with them.

Foremen's school is quite distinct from the higher technical school.

The Royal Foremen's School is divided into—

(*a.*) The mechanical division, from Michaelmas to Easter;

(*b.*) The chemical division, from Michaelmas to Easter;

(*c.*) The mechanical division from Easter to Michaelmas and thus, in its two main departments, it is a winter school.

Mainly a winter school.

The subjects taught in the three courses consist of arithmetic, geometry, physics, geometrical drawing, freehand drawing, German, general principles of chemistry, mathematics and mechanics, machinery in general, mechanical technology, machine drawing, surveying and water measurements, practical chemistry in the laboratory, technical chemistry, mineralogy, book-keeping, and architectural drawing. In addition to these subjects, the students in the second and third courses have the opportunity of attending special lectures, as for example,—on mills, and their construction; spinning, with the various materials; weaving, ditto; waterworks; tool construction for machinery; brewing; calico-printing; paper manufacture; and fire-extinction apparatus.

Subjects taught.

In all the divisions, a feature of this school is that visits are paid by the students to works; permission for which is readily given.

This foremen's school is almost unique of its kind in Germany, and is of an experimental character; Dr. André, the Burgomaster, with whom the Commissioners had the pleasure of conversing, expressed his high opinion of the benefits exerted by this school on Saxon industries.

(C.) A third division of this school is the *Royal Building School*, forming an adjunct to the State educational institutions, and affording the means of education to those who wish to prepare themselves for any branch of the building trade. The pupil must be 16 years of age, and must have passed certain qualifying school examinations. He must give his whole time, and must have been employed in practical building for two half-years previous to entry. The fees are 30*s.* for each course of half-a-year; the expense of materials comes to about 25*s.*; and poor students can obtain a remission of the fees. This school is parallel with the Royal Foremen's School above mentioned, and is for young workmen who have worked manually in their trade, and want to educate themselves theoretically and systematically. The students are mainly young stonemasons, house decorators, carpenters and joiners, and especially those handicraftsmen who intend devoting themselves to the more ornamental part of their trade.

Royal Building School.

Course of instruction.

The course consists of four half-years, and includes the following subjects:—General principles of building, elements of form and architectural drawing, freehand drawing, mathematics and arithmetic, geometry, descriptive geometry and perspective, German language, construction in stone, in wood, and in metal, laws respecting building, designing plans, physics, preparation of estimates, history of the art of building, mechanics, heating and ventilation, land surveying; and book-keeping.

Royal Drawing School.

(D.) The fourth division is the *Royal Drawing School*.—This is an evening school, for teaching art in its various branches, and is attended by pupils from the mercantile and other schools in the town, the pupils, in fact, being drafted from all classes. Instruction is given on four evenings in the week in freehand drawing, drawing from casts and models, machine drawing, and construction and architectural drawing. The fees are low, and bring the school within the reach of all.

The budget of the school is as follows:—

	£
State subsidy - - -	7,700
Town do. and sundry receipts -	240
Students fees - - -	1,235
Total -	9,175

Plans and elevations of this institution are contained in the Special Appendix 5, Vol. V.

Industrie-schulen of Bavaria.

The Royal Industrie-Schule, Munich.—There are four Bavarian schools, the so-called "Industrie-Schulen" of Munich, Augsburg, Nuremberg, and Kaiserslautern, intended to serve for the training of those who desire to pass at once into industrial occupations. The school work done in all of these schools, which was thoroughly and fully displayed at the Nuremberg Exhibition, was carefully examined, and two of these schools, that at Munich and that at Nuremberg, were visited by the Commissioners.

The school at Munich, of which Herr Kleinfeller is the director, is divided into four departments:—

1. Mechanical Engineering.
2. Chemical.
3. Building Construction.
4. Commercial.

State institutions.

The building, which was erected by the State, cost originally 15,000*l.*, but it has lately been considerably enlarged. There are 152 pupils, and the annual budget amounts to 2,500*l.* All the expenses of this school are defrayed by the State.

Course of instruction.

The course extends over two years, and is so arranged as to furnish an education complete in itself; but it has been found in practice that a large proportion of the students trained here pass on subsequently to the Polytechnic School to finish their education, and the original aim of these schools has thus been somewhat modified. The students are admitted with the leaving certificate of the upper class of the Real School, or on showing that they possess the requisite ability. There are no evening

classes, and very few pupils come here who have been previously engaged in practical work.

In the first division the subjects taught are distributed over the two years as follows:— Programme for mechanical engineering.

1st Year.

	Hours.
Mathematics	7
Descriptive geometry	5
General physics	4
Machine work	2
Machine construction	10
German, French, and English languages	7
Practical work in the shops	5
Total	40 hours.

2nd Year.

	Hours.
Differential and integral calculus	3
Land surveying (in second term)	2
Physics	4
Technical mechanics	2
Machine work	2
Machine construction	12
Mechanical technology	2
German, French, and English languages	7
Practical work in shops	5
Total	39 hours.

In the chemical division instruction is given in mathematics, physics, theoretical chemistry, mineralogy, machine construction, French, German, and English, together with 14 hours per week of practical work in the laboratory. Course for chemists.

In the third division great prominence is given to architecture and drawing, 12 hours weekly being devoted to these subjects in the first year, and 21 in the second; languages occupy seven hours per week in each year, and there is no practical shop work. Course for architects and builders.

In the commercial division greater attention is paid to the languages and book-keeping, to the former 14 hours per week are devoted, and to the latter 4 hours. Technical chemistry and the quality of produce of various kinds (Waarenkunde) are also studied. Commercial division.

There were 26 students at the time of our visit in the first division, 18 in the second, and 30 in the third; the remainder being in the commercial division. The students pay 4*s.* as entrance fee, and 1*l.* 16*s.* per annum for the complete course.

Building trades school.

In connection with this institution is a winter school for those engaged in the building trades, attended by 103 students. The course extends over three half-years, and is intended for workmen and others practically engaged in building operations during the summer months. The requisite preliminary knowledge is only that of the primary school. In the first year's course there were 44, in the second year 32, and in the third year 27 students. The fees are 1s. on entrance and 20s. for the semester. Those unable to pay the fees can obtain exemption. The courses involve 54 hours of instruction in each week, as follows:—

First Course.

	Hours per week.
German	4
Arithmetic	4
Natural history	3
Plane geometry, linear drawing, and the elements of projection	10
Freehand drawing	8
Building construction and architectural drawing	18
Modelling	4
Ornamental writing	3

Second Course.

	Hours per week.
German	4
Commercial book-keeping	2
Natural history	2
Algebra	4
Stereometry, with descriptive geometry and projection of shadows	9
Freehand drawing	8
Building construction, with practical exercises	16
Masonry, stone joints	4
Modelling	4
Writing (ornamental)	1

Third Course.

	Hours per week.
German	2
Mathematics	5
Surveying	2
Mechanics	4
Chemistry	4
Freehand drawing	4
Perspective	4
Architectural styles	6
Masonry, stone joints	4
Planning and estimating	18
Rudiments of the laws relating to building	1

The Commissioners were conducted over the school by the director, and visited the chemical laboratory under the charge of Dr. Feichtinger. There is a large collection of preparations made by the pupils. In the model room next visited were specimens of pumps, valves, gearing, &c. Also sectional working models and apparatus for teaching mechanics, chiefly made in the school. Chemical laboratory. Models.

The drawings shown us were extremely creditable, many of them being carefully measured from actual machinery. In the art room were casts of ornament, foliage, &c., but no antique classical figures. The room is divided by transverse screens, so arranged as to shut off the light from more than one window in each bay. There is a special room for architectural drawing, in which advanced work was in progress. Drawing.

The workshops are situated in a separate building behind the school, which was being extended at the time of our visit. The power employed to drive the lathes is supplied by a 2-horse power gas engine and a 6-horse power steam engine and boiler. There was a good supply of the usual tools in the fitters' shop. The joiners' shop was small, but would be transferred to a larger room when the alterations were complete. Each student has a capital chest of tools, fitted with lock and key, for his own separate use. The minding of the engine and boiler is done by two of the boys, who each take the duties of driver and stoker in turn. They have to calculate the speed and power, water evaporated per kilo. of coal, &c. Workshops.

The boys make the tools and fittings for the shop; they also make tools and models for sale. A foreman engineer has charge of this instruction, and the boys are said to be very fond of the work, which they find to be of great practical utility when they leave the school.

The Royal Industrie-Schule, Nuremberg.—This was formerly a Polytechnic School, but was converted some years ago to its present use, as it was felt that the new Technical High School at Munich was sufficient for the whole of Bavaria. The school has 102 students, 48 of whom learn practical work in the shops. They spend nine hours per week at industrial work. The course extends over two years, and the school resembles in all its main features that at Munich. The chemical section, numbering 18 students, is in charge of Dr. H. Kæmmerer, who showed us his well arranged laboratory and collection of upwards of 4,000 preparations. Industrial School, Nuremberg.

The workshops are lofty and well supplied with tools, including numerous lathes, slotting machines, &c., all made in the school. There is a foreman instructor and two assistants. No steam power. The show of drawings from this school at the Nuremberg Exhibition was particularly good; also the apparatus and machinery made by the pupils. The fees are very moderate. Workshops.

We have not found schools which can be placed in this section either in Austria or in the Netherlands

(7.) Secondary Technical Schools in Italy.

Technical Institute of Milan.

The Technical Institute of Milan.—Schools of a similar kind to those of Bavaria, which likewise form an integral part of the school system of the country, are the Technical Institutes existing in Italy. These institutions, of which there exist over seventy, are very similar in character, and their courses of instruction are determined for them by the Government Educational Department. They comprise generally three sections or divisions,—(1) chemical; (2) physical and mathematical; and (3) a special section devoted, according to the prevailing industry of the district, either to agriculture, naval architecture, or weaving and dyeing. The pupils enter these schools on leaving the technical schools (*scuola tecnica, see* p. 27 ante.), the leaving certificate being the only requisite qualification. In the physico-mathematical departments of these institutions no workshop instruction is given, as the Italians do not generally attach importance to manual work executed in the school. The school is regarded as a bad substitute for the workshop in industries in which the machines used and the tools employed are frequently being changed and modified. It is looked upon as the place for instruction in principles and modes of applying them, and not as a place in which manual dexterity is to be acquired. Signor Brioschi, the director of the above Technical Institute, from whom the foregoing opinions were obtained, considers that it is better to send pupils to the workshop than to bring the workshop into the school.

Opinions in Italy respecting school workshops.

School occupies an old convent.

The Technical Institute of Milan is situated in the Via San Marco. Like most of the schools and many of the private houses of Milan, it was originally a convent. We had the opportunity of being present when lessons were being given in the ordinary subjects of instruction, and likewise of inspecting the appliances and methods of teaching for the special subjects. In one room we found a class of boys receiving a lesson in trigonometry, in another the subject was history. The walls of the rooms were perfectly bare, and no attempt seemed to be made to illustrate the subject of instruction. The master was lecturing and the boys were listening.

Drawing.

As in the other Italian schools visited, the appliances here for teaching drawing were good, and the instruction in this subject was both general and technical.

Physics.

Several rooms of the school or college are occupied by physical apparatus for the instruction of those who enter the physico-mathematical section. Here we found the ordinary apparatus used in elementary physical experiments, besides special apparatus of a more costly kind. No attempt is made at practical physical work on the part of the pupils. The apparatus is for illustration and explanation only. The sum of 32*l.* is allowed yearly for the purchase of new physical apparatus.

Agriculture. School Museum.

The museum of the department of agriculture contained models and illustrations of much with which a practical agriculturist has to be familiar, besides actual specimens of a great variety of natural products. Here were collected, and well classified, different kinds of ploughs and other agricultural implements and machinery; specimens of tools, historically arranged; collections of herbs, cereals, roots, &c.; diagrams of cattle, indigenous to various countries; specimens of woods, showing the vertical, horizontal, and oblique sections, and the polish of which each kind is susceptible; preparations exhibiting the chemical constituents of vegetable substances; models of different kinds of apples, pears, fruits, &c., indicating where they are severally grown; specimens of the soil taken from different parts of the valley of the Po; the various kinds of grapes; models and diagrams of the phylloxera, and of its effects on the plant, &c., &c.

The number of students attached to this department is small in this particular school. At the time of our visit there were 17 only. It was stated that in the South, the agricultural schools are much better frequented, but in the plains of Lombardy the richness of the soil was said to render the agriculturist somewhat indifferent to the advantages of technical training.

Chemistry.

A no less interesting department of the school was that devoted to chemistry. The general laboratory for the students occupies what was formerly the convent church. It is in the basement of the building. Several other rooms adjoining it, together with a small lecture theatre, are also appropriated to chemistry. The general laboratory affords accommodation for about 60 pupils to work at the same time. The instruction embraces the metals and metalloids and qualitative analysis. The apparatus is on an extensive scale. Three or four rooms are devoted to the use of the professor, and for various kinds of apparatus. We found here numerous instruments of an expensive character. One room was occupied by physico-chemical apparatus, including batteries, spectroscopes, &c.

The professors of the three divisions into which the teaching of the school is divided, are each persons of scientific authority in their own branch of study.

Technical Institute of Como.

The Technical Institute of Como was also visited by the Commissioners. It is divided into three sections, the course extending over four years. I. Physical and mathematical, II. Commercial, and III. Industrial, with special reference to the manufacture of silk. The third department, the silk school (*scuola di setificio*), containing a dyeing and weaving school. The director is Professor L. Ponci. The students enter with the leaving certificate or diploma of the technical school, the average age on admission being 14 years. The entrance takes place in October.

Fees.

The fee is 2*l.* 8*s.* (60 francs), which may be wholly dispensed with in the case of poor students. About half the students at this school are admitted without payment. The course during the first two years is common to all the students, but in

the third and fourth years there are special courses for each section. The instruction includes French and Italian literature, geography, history, mathematics, and drawing in the first year, and the same in the second year, with the addition of German. For the silk school, physics and natural history take the place of German.

Technical instruction begins with third year.

No special technical instruction is given until the commencement of the third year. In the third year, in the commercial department, the students have the elements of political economy and civil law, together with book-keeping and accounts. In their fourth year the students take up chemistry including laboratory work, natural history, applied economy, and accounts. The students in the silk school learn in their third year the elements of political economy, applied mechanics, ornamental design as applied to fabrics, and dyeing of silk. In the fourth year they take the theory of statistics, applied economy, practical chemistry, the chemistry of dyeing, applied mechanics, ornamental design, silk dyeing, practical weaving, computations of fabrics, &c. The Government pays half the cost of the school and the commune the remainder. Students pay 16 shillings (20 fr.) per annum for the dyeing materials, and 20 fr. for the chemical laboratory expenses. The school is held in an old convent, and is not well adapted for its present purpose. We were informed that a new weaving shed and a new chemical laboratory were about to be erected. A new drawing school will also be added. The existing laboratory is poorly fitted for 16 students; the dyeing arrangements are quite unworthy of such an institution. The drawing school contained some fairly good examples of shaded ornament and foliage, the casts were mostly very small: the lighting was indifferent.

At the Milan Exhibition of 1881 there were some excellent notebooks from this school. We were accompanied through the building by the director and Signor Cadenazzi, the teacher of applied mechanics and machine drawing, who is a civil engineer in practice in the town. The teacher of German, who was absent at the time of our visit, is an Englishman.

Technical Institute of Udine.

The Technical Institute of Udine.—This is similar in many respects to the Institute in Milan already described, and constitutes one of the seventy institutes of this class in Italy. It is divided into 4 sections; (1) mathematical—physical; (2) commercial; (3) agriculture; (4) levelling and surveying (agriminsure). Besides these four sections, there is a general industrial division for students who are training for posts in manufacturing concerns. There is an agricultural station and a farm connected with this school. The institute is exceedingly well provided with laboratories, collections of apparatus, and museums, The chemical laboratory has places for 24 students to work at a time, and the students of all sections are engaged in laboratory practice for a certain number of hours per week, which vary according to the importance of this branch of study to the future work of the student. The laboratory is

Chemical laboratory.

under the direction of Professor Nallino, and the sum of 120*l.* a year is allowed for its maintenance. The geological cabinet is well furnished with models, diagrams, minerals, and fossils, which serve especially to illustrate the geology of the surrounding country. There is also a well arranged natural history museum occupying a very large room; all the specimens are well classified and placed in suitable cases. Besides these collections is a museum of agriculture, similar to that we have described at Milan. The cabinet of physics contains a large quantity of good and useful apparatus, including a Siemen's dynamo-machine, different kinds of electric lamps, and various other instruments. As is the case in most of the Italian technical schools, the mechanical department contains a great variety of kinematic models, and also models of machines and of parts of machines of full size, most of which were made by M. Blotto, at the Palazzo Valentino, in Turin. These models are used not only for the purpose of illustrating the teaching of mechanics, but also as objects to be drawn by the students. The drawings were very good. In the fourth section there is a small museum containing a collection of theodolites, sextants, levelling and surveying instruments, &c. On the roof of a portion of the building is a small observatory, with telescope, &c., and containing also meteorological apparatus, including an anemometer, hygrometers, and apparatus for determining the electrical condition of the atmosphere. Special rooms are devoted to art work, and drawing is an obligatory subject for students of all the different sections.

Museum.

Apparatus.

Models.

Observatory.

This short notice of the museums and collections attached to this technical school in Udine gives some idea of the facilities afforded in the capital of nearly every Italian province for practical instruction in different branches of applied science.

Facilities in Italy for technical instruction.

The attendance of students is comparatively small, considering the size of these institutions and the cost of their erection and maintenance. There are 120 students in this college, 17 professors and 3 assistant teachers. The age of the students is from 17 to 19. The director, Professor Misani, stated that the inspection of these institutes on the part of the Central Government is too lax, and that insufficient opportunity is offered to the professor to suggest changes in the system of instruction which is determined by the Education Department for all these institutes.

Number of students and professors.

This institute has been in existence for 17 years, but the farm has been established only two years. Experiments are prosecuted on this farm, and besides the regular students of the institute who come here for practical lessons in agriculture, the small farmers of the district attend occasionally to take part in them. Sheep, oxen, and other animals are reared on the farm, and all the different kinds of grain adapted to the district are grown. There is a room especially fitted up for the microscopic examination of seed with the view of detecting adulteration, &c. The accounts of the farm are most carefully kept by the students, and during the first year the farm was maintained at the small loss of 19*s.* 2*d.*, so nearly did the accounts balance.

Experimental farm.

The Commissioners visited a very similar institution at Venice,* which contained very excellent appliances for practical scientific teaching.

General Review of Continental Secondary Technical Schools.

General review of continental secondary technical schools.

The secondary technical schools or colleges, referred to under sub-section B, constitute as important a feature in the educational systems of most continental countries as those described in group A. In these institutions the majority of those who are to become managers and sub-managers of industrial works receive their training.

The theoretical instruction is not carried so far in these colleges as in the German Polytechnic Schools and in the École Centrale of Paris, herein-after described, which are available for the higher education of those who can afford to prolong their studies to the age of 22 or 23, and who are intended for occupations in which a very advanced knowledge of mathematics and of science is required.

From the character of the instruction which students receive in these establishments, and from the age (19 or 20) at which they leave them, it will be seen that these institutions are co-ordinate with the technical departments of many of our own colleges, such as University College, Nottingham, the Firth College, Sheffield, and others which have been recently established with nearly similar objects, in our chief manufacturing centres.

In affording an education in which theory is not carried too far and is duly combined with laboratory practice, and in some cases with workshop instruction, and in which, moreover, the scientific teaching is made to bear upon the principal manufactures of the districts, these higher technical schools provide the kind of education that is best adapted to the various grades of managers of works.

C.—Building, Engineering, and Mining Schools.

Building, engineering, and mining schools.

In this third sub-division of intermediate technical schools we have three main groups, which lend themselves well to separate consideration, though they necessarily differ greatly among themselves in the rank of the pupils for which they are intended. We are therefore compelled to abandon our attempt to confine this group simply to the class of foremen and those likely to occupy the lower positions in industrial concerns, and we take here schools of

* The professional school of Biella, described among the weaving schools, p. 155, also ranks as a Technical Institute.

various grades, but giving a specialized instruction suitable for builders, for engineers, and for miners.

The first group, that is, building schools, are found principally in Germany and Austria, and do not exist as independent schools in either France, Belgium, or Italy. They resemble one another very closely in character and afford little actual trade teaching. Their chief object is to impart theoretical instruction adapted to the wants and requirements of superior workmen and foremen engaged in the building trades. Incidentally they serve for the education of draughtsmen, surveyors, inspectors of works, and occasionally of a lower grade of architects. Building trade schools.

The second group is conspicuously represented on the Continent by the French schools for the training of mechanical engineers, the Écoles des Arts et Métiers. A school of a somewhat similar type, visited by the Commissioners, in Holland, and the Austrian school at Komotau, may best be described in this section. Mechanical engineering schools.

The various schools for miners which exist in all parts of the Continent contain students of every grade. We have dealt in this third group with all the mining schools, except those of the highest rank, which come more properly in the section of schools for superior managers and proprietors of industrial establishments. Mining schools

Building Trade Schools in Germany.

The Building Trade School at Stuttgart is one of the most important schools of this kind in Germany. The building is a magnificent modern structure, designed by Professor Egle, who is also president of the school. The cost of the building was above 50,000*l.*, and the annual budget for 1880–81 amounted to 7,378*l.*, of which 973*l.* was contributed by the payments of the pupils, the remaining sum of 6,405*l.* being paid by the State. The school is divided into two mathematical preparatory courses, and three special science divisions, (1) for those engaged in the building trade, (2) for land surveyors and land agents, and (3) for mechanical engineering. There are 28 masters of departments and 13 assistants. It is important to notice that, unlike the French, Swiss, and other schools of the same kind, the higher technical education of Germany is not gratuitous. The pupils pay 36*s.* per half-year, no one is admitted under 14 years of age, and many, having been engaged in practical work, are of mature age. The number of scholars in the winter course was 448; more than half of these belonging to the building trade; the average age being 21 years. The summer course was attended by 133 pupils. The course in each half year is the same. There are six courses of half a year each, and a considerable proportion of the students remain for this length of time. As many of those attending the classes are almost illiterate, preparatory courses of ordinary study are carried on together with the technical work. Building trade school, Stuttgart.

The subjects taught are; mathematics, physics, general geometry and statics, freehand and ornamental drawing, geometrical Subjects of instruction.

drawing; building construction, consisting of lectures, drawing, and designing; surveying and mensuration, including lectures and practical field work; machine construction, including lectures, drawing, and designing; special drawing for joiners; gymnastics.

Teaching of drawing.

The drawing is taught as follows: The student begins with plane geometrical drawing, and passes on through a series of graduated examples until he finally makes complete designs for public buildings, with the plans, sections, elevations, and perspective drawings. Professor Egle has a special method of teaching the projection of shadows, by means of parallel planes arranged to follow in contours of equal illumination.

The arrangement of the building is very commodious, and much care and thought have been bestowed on the questions of lighting and heating, as also on the general fittings of the school. This institution appeared in every way thoroughly adapted to workmen, and seemed a typical school for artizans. Drawing in all its applications to industry was most carefully taught, and the studies of the pupils evinced a thorough acquaintance with the subject.

This is in no sense an apprenticeship school, as no practical work of any kind is attempted. The object of the school is to supplement the instruction of those practically engaged in the various branches of the building trade. With the exception of modelling from plaster casts, the whole of the teaching is purely theoretical. Here, again, we see the importance of the principle insisted upon in Germany of the continuation in the Fortbildungsschule of the education begun in the primary school. Only a few of the best of the pupils in these schools come to them from the Real schulen.

Building trade school at Dresden.

The Building Trade School at Dresden is very similar to the above. The course consists of four consecutive winter sessions; it being understood that the pupils are occupied in their various trades during the intervening summers. On entry the pupil must be 16 years of age, and must have passed through the elementary school. The pupils pay 30*s*. for each course. Like the other schools of its class, this is entirely a day school.

Programme of each course.

The first course consists of the general principles of architecture, architectural drawing, freehand drawing, arithmetic, geometry, projection, and German. The second course consists of the general principles of architecture, building construction in stone and wood, the laws relating to building, the elements of architectural drawing, designing, freehand drawing, mathematics, physics, perspective, and German. The third course comprises building construction, structures in stone and wood, plans of buildings, history of architecture, designing, freehand drawing, mathematics, physics, mechanics, and German. The fourth course consists of building construction, including construction in iron and other metals, modes of warming, heating, and ventilating buildings, designing, freehand drawing, mechanics, perspective, surveying, levelling and plotting, and bookkeeping.

This school may serve as a type of the Saxon building schools, of which there are four principal ones. All of these schools, being under the Minister of the Interior, have an identical organisation.

The Building Trade School of Chemnitz forms part of the Higher Trade School which we have elsewhere described. A school of a similar character is attached to the Munich Industriel-Schule, *see* p. 94, and there is also a Building Trades school in connection with the Berlin Handwerker Verein, *see* p. 41.

Building Trade Schools in Austria.

There are two types of Building Trade Schools in Austria, the one being called the State Trades Schools (Staatsgewerbe Schulen), and the other the Foremen's Schools (Werkmeister Schulen). The more important of the former class are those of Reichenberg, Brünn, Graz, Salzburg, Bielitz, Pilzen, Czernowitz, &c. Many of these are only winter schools, because the workmen are employed in their ordinary vocations during the summer months, but, during the hard continental winters, they are unable to carry them on. Some of these are only winter building schools, whilst others embrace a wider range of instruction and more nearly correspond with the Industrie Schulen of Bavaria (p. 94), serving the purpose of training men generally for intermediate posts in industrial works. Austrian building trade schools.

Schools of this kind vary considerably according to the requirements of the district in which they are situated. Thus, for example, the school at Graz contains two divisions, one for those in training for, or already engaged in, any one of the different branches of the building trade, and the other, an applied art division for the various trades in which art knowledge is necessary.

To this school is also attached a continuation school (Fortbildungsschule), and an evening and Sunday school for journeymen and apprentices. These evening schools continue the instruction of the primary school, with, in addition, suitable lessons in drawing adapted to the various industries, together with modelling, wood carving, &c.

All these schools have for their object either to give a special preliminary training to workmen who are about to enter various industries, or by means of winter, evening, or Sunday instruction, to supplement, by theoretical teaching, the education of those who are already engaged in trade or business as workmen or foremen.

The Commissioners visited the Vienna Building Trade School during the summer months, when few students were present; also the schools at Innsbruck and Salzburg (*see* Special Report on Domestic Trades, in Appendix). One division of the Reichenberg Trade School described on p. 83, ante, is a Building Trade school.

Building Trade Schools, Vienna.—There are two schools of this kind in Vienna, the aim of them being to give to apprentices Vienna building trade schools.

and young men engaged in the building trades a theoretical knowledge of all the details of their industry.

These schools are open all the year round, but the summer courses are thinly attended, because the great majority of students are employed at their work during the summer, and are saving money to enable them to attend the schools when building operations are suspended in the winter.

In the one of these we visited there are 150 pupils in winter, and 50 in the summer. The fees amount to from 1*l.* 13*s.* 4*d.* to 2*l.* 18*s.* 4*d.* for the half year.

Boys come to the school at 15, and usually go through a two years' course, with half a year for preparation, if not sufficiently advanced.

Instruction is theoretical.

The instruction is almost entirely theoretical, but in certain difficult operations experimental work is done by the classes. The pupils are mostly sons of builders, contractors, and small employers. The school has existed since 1868. It is situated in rather a thickly populated portion of the city, in order to be near the homes of the students. The hours are from 8 to 12 in the morning, and from 2 to 6 in the afternoon. The school receives 917*l.* from Government, and 83*l.* from the town.

Evening school.

In addition to day school work, the rooms are used for evening and Sunday schools, and attended by from 150 to 200 pupils, who are required under their conditions of apprenticeship to come for two nights a week and on Sundays. This department of the school is largely supported by the Masters' Association.

Numbers in each course.

The preparatory class contained seven boys, 14 to 15 years old, who were studying geometry. The papers in geometry and in perspective were neatly executed. We inspected some of the drawings in books, copied from black board drawings, and creditably done. The freehand, outline drawings, and coloured designs of ornament were very good. In the first course were six boys, 15 to 17 years old, who spend most of their time in drawing and in studying the sciences bearing on construction. They devote 12 hours a week to perspective, geometry, and lectures, and make detail drawings of wood joints, scarfed tie beams, &c. The second course included 15 students, 17 or 18 to 25 years of age. We saw some clever drawings of details of architecture and construction, but the freehand and shading was not good. The third course comprised 10 students, who were drawing from casts and making original designs, plans of buildings, finished drawings, &c., with elevations and sections. In the fourth course were two students. It must be seen that these small classes indicate a great waste of teaching power; but we were informed that everything is as different as possible in the winter. Most of the students have had more or less of workshop experience before they come.

Two free studentships are offered by the Gewerbeverein.

Work of advanced

The most advanced students make complete architectural drawings, in addition to which, they calculate all the quantities of

material required, prepare specifications, and work out estimates in detail, and show, as a contractor would have to do, the cost at which a building can be erected. They hand in *pro formâ* "tenders," which are examined by the teacher, and the first place is given to the student who is most correct in his calculations, "planning," and "setting out," and who shows correct judgment of the price of the work to be done. Most of the students become draughtsmen, builders' foremen, clerks of works, and some become architects. There is an annual exhibition of drawings and designs, and friends are invited to see them.

Collection of models, &c.

A large room is filled with cabinets of building materials and models of all kinds, chiefly examples of building construction. There are roofs, arches, suspension bridges; in fact, it may be said that there is not a building difficulty which is not represented by some model, showing how it may be dealt with. There are also books of drawings, photographs, and descriptions of buildings, and information relating to architecture generally.

The aim of the Vienna School is to give intelligence to builders, and this is the first and safest step towards the construction of good buildings.

The professors spoke with confidence and enthusiasm of the results of the school.

General remarks on building trade schools.

In considering these schools, among the points to be noted are, first, that the pupils are required to have had a fair preliminary education before entering them, or to supplement it in the school itself. Second, the instruction is mainly, if not exclusively, theoretical. Third, that throughout the entire course of instruction great attention is paid to freehand and geometrical drawing; and fourth, nearly all the students are or have been practically engaged outside the school in the work of their trade. It seems necessary that we should here draw special attention to the fact that parents not only make great sacrifices for the education of their children, but that the young men themselves work hard during the summer months to save sufficient money to pay their school fees and to support themselves during the winter when work is slack.

Mechanical Engineering Schools in France.

Mechanical engineering school at Châlons.

Amongst the continental schools for the practical training of foremen engineers, the French *Écoles des Arts et Métiers* stand conspicuous. The Commissioners visited the school at Châlons sur Marne, one of three of the same rank existing in France, the other two, on exactly the same pattern, being at Aix for the south and Angers for the west. There is a fixed geographical limit for each of the three existing schools. All the pupils at Châlons come from the N.E. of France. A fourth school of this type is about to be founded in the town of Lille; and a fifth has, we believe, been commenced at Nevers. The Commissioners were introduced by M. Jacquemart, the Inspector General of Technical

Instruction in France, and were received by M. Langonet, the Director. These schools are State institutions, in which practical mechanical work in the shops is the main subject, supplemented by theoretical studies. The object of the schools is to train competent foremen and draughtsmen, especially for engineering works. The pupils spend 6¾ hours per day in the workshop, and are occupied for 6 hours in school work. The schools in question were founded in the year 1803–4 by a decree of Bonaparte when First Consul. The original organization differed widely from that which they have at the present time assumed. They are placed under the direct control of the Minister of Agriculture and Commerce, and under the superintendence of the Préfet of the department in which they are situated. The course extends over three years. As is the case with many of the French schools, the students are all boarders. The number of students in each of these schools must not exceed 300, who are divided into three sections (corresponding to years) of 100 pupils each. A large number (about one half) are free students, being admitted by exhibitions from schools of a lower grade. The scholarships are awarded by the Minister, by the Departments, and by the municipalities. The rest of the students pay 24*l.* a year; the cost per student is, however, 56*l.*, the difference being defrayed by the State. The total expenditure for the year previous to our visit would be somewhat in excess of this sum, and would reach nearly 60*l.* for each student; the budget being 16,680*l.* for the 285 pupils. The State subsidy varies from 14,400*l.* to 15,000*l.* per annum. The sum of 2,800*l.* has just been voted for new machinery for the workshops, as the existing plant, which has been mainly constructed by the students, is antiquated and not in accordance with modern requirements; it is estimated that a sum of not less than 5,600*l.* will have to be expended for this purpose. Tools and machines made in the workshops by the students are sold each year and produce from 1,200*l.* to 1,400*l.* The pupils are admitted on the results of two examinations, a preliminary test examination which is competitive, and embraces French, arithmetic, geometry, drawing, and manual work, and a final examination at the school. Many of the large public schools, such as the Paris Écoles Turgot and Leon Say, have special preparatory classes for this institution. There is also a school in Châlons, conducted by M. Gosserez, which succeeds in passing many pupils into this school. Out of 60 candidates sent up last time for the preliminary examination, 53 of M. Gosserez's boys qualified for the second examination, and 35 passed the final examination.

Object of the schools.

State subsidy.

Course of workshop instruction.

The 100 youths who enter each year are separated into two divisions of 50 each, one section going to the fitting shop and the other to the pattern shop. They pass through the shops in six months and then change about. In the fitting shop, which is divided into three sections, one of which corresponds with each year of training, there is a large stock of plant, an engine and boiler, which the students manage in turn for a week each, as stoker and driver,

and a tool store from which the necessary tools are issued; the students make squares, compasses, vices, &c. In the second year they pass on to detached portions of machinery and make small simple machines. In the third year they are employed in the production of machines either for actual use in the school, or for sale outside. The school, in undertaking contracts for work, will not bind itself to deliver at a given date, and therefore does not compete with any manufacturing establishment.

Foundry. The foundry contains three cupolas, one of which serves for heavy castings; among the objects cast are headstocks and beds for lathes, and frames for spinning machines. At the time of our visit they were at work on a casting weighing 30 cwt.

Smithy. The smithy has eight forges. Two students work at each and take it in turns to act as smith and striker. Among the articles made are vices, screw presses, copying presses, &c.

Pattern shop. The pattern shop has places for 100 students, it is well provided with tools and admirably arranged. Patterns are made for lathe-headstocks, beds for lathes and planing machines, driving-pullies, &c.

In all the workshops, in addition to special foremen-instructors, a few regular mechanics are employed.

Divisions of the school. The accompanying table shows the shops in which the students of each year are distributed:—

Divisions of the School.	No. of Students in each Workshop.			
	Fitters.	Founders.	Smiths.	Pattern Makers.
1st year students -	50	—	—	51
2nd „ „ -	31	15	34	15
3rd „ „ -	69	10	7	8
Totals -	150	25	41	74

The time table of the school is given in Appendix No. 15, Vol. V.

Students mostly select fitters' shop. The bulk of the students in all these schools are found in the fitters' shop; indeed, if the students had their own free will, it would be difficult to find recruits for the other trades. The position in the shops is given in accordance with the results of the annual examinations, unless a youth voluntarily chooses to work in one of the less preferred departments. The discipline in these schools is of the most rigorous character; the students wear a semi-military uniform, and are closely confined to the school, which they only leave at rare intervals under the charge of an instructor. There is a total absence of games and athletic sports.

On being questioned on this subject the Director said the students were too tired when they left the shops to care for further exercise.

French opinion respecting these schools.

Opinions differ in France respecting the merits of the students trained at these schools. When they enter active life it is found that they still require considerable preparation before they are competent to take charge of work. The defect of the teaching is mainly its failure to give a sufficient appreciation of the value of time as an element in practical work, and a tendency to minute and artificial finish.

Positions taken by pupils of the school.

The Commissioners ascertained the position obtained by the pupils on leaving this school, and found that they were engaged in a variety of occupations, among which the following may be mentioned: draughtsmen in manufactories, chiefs of drawing offices and directors of works, managers of shops; a few become teachers of engineering construction as M. Bocquet, of *la Villette* school; many hold posts of various kinds on railways; very few relatively remain workmen or even simple foremen. They generally enter works in the first instance as simple workmen, but owing to their superior technical training they rapidly rise to the position of foremen.

Comparison between the students of these schools and those of the École Centrale.

From the opinions elicited from manufacturers and managers of works in France, the Commissioners ascertained that in many cases the pupils from these schools were found more efficient subsequently as managers and heads of departments than those from the École Centrale and the École Polytechnique, inasmuch as their training had been of a more practical character, and that they were more ready to adapt themselves to the requirements of the different kinds of work, and more capable of receiving new impressions.

Defects of such schools.

One evident disadvantage of any school of this description, which takes the place entirely of training in a commercial workshop, is that the machinery must quickly become antiquated, the newest inventions not being likely to be as speedily introduced as they would be into a workshop in which machinery is being manufactured for the market. This objection indeed was recognised by the director, who pointed to the fact, already mentioned, that a sum of 5,600*l.* was then required for the purchase of newer machinery.

Advantages.

On the other hand, it must be admitted that the students have the opportunity of learning different processes more speedily under the direction of foremen who are specially provided to give instruction, than they would do in an ordinary workshop in which each man is put to that work which he is capable of doing most efficiently in the interests of the concern; always providing that the foremen themselves are competent.

Whilst not advocating the adoption of such schools as this in England, the Commissioners have no doubt that by combining in their system of instruction, practice with theory, these schools have exerted a beneficial influence on the industries of France, and that by gathering up, as they do, the selected boys from schools of a lower grade distributed over a wide area (22 Depart-

ments sending their pupils to this one school), they are the means of training an intelligent and efficient class of persons, capable of ultimately filling responsible posts in industrial establishments, and from the experience which the Commissioners gained in visiting some of the largest machine works of France they have found such to be the case.

Mechanical Engineering Schools in Austria.

The Royal Mechanical School of Komotau in Bohemia.—This school is avowedly designed on the model of the Technical School at Moscow. It was opened on the 26th October 1874. The director, Professor Reuter, now at the Iserlohn School, *see* p. 50, having previously inspected the various European methods, gave the preference to the system adopted at Moscow, and introduced the Russian plan, with the important modification that the manufacture of articles for sale is here omitted, and the full course lasts only two years at Komotau instead of three. The school, of which Professor Rörer is now the director, was originally planned for 48 students, but it has recently been largely extended to accommodate the increasing numbers seeking admission. The minimum age for admission is 14, but students of all ages up to 26 are to be found in the school. The students are under instruction for nine hours daily, from 8 to 12 in the class rooms for theoretical instruction, and from 1 to 6 in the shops. The chief attention is paid to the practical shop-work, the literary instruction being mainly directed to its bearing on the industrial work of the student, and his needs as a skilled mechanic. Mechanical school of Komotau.

The course of study is as follows:—

1st year's course in shops.—1. Carpentry and joiners' work, 30 hours per week for 16 weeks. 2. Wood turning, 30 hours per week for 12 weeks. 3. Hand-tool work in metals, 30 hours per week for 12 weeks. In this course typical articles to be fitted are employed as models, preparatory to a course later on, in the second year, on the practical applications of the same. The student spends four consecutive weeks in each shop in turn. Course of study first year.

1st year's course of theoretical instruction.—1. Linear drawing and the theory of projection, 10 hours per week. 2. Free-hand drawing, 4 hours per week. 3. Commercial hand-writing (in winter), 1 hour per week. 4. Arithmetic (in summer), 2 hours per week, (in winter) 5 hours. 5. Geometry (in summer), 3 hours per week. 6. Physics, 1 hour per week. 7. Theory of machine construction, 2 hours. 8. Simple book-keeping and commercial practice, 2 hours. In all the above subjects the teaching, though very simple and elementary, is thorough and sound.

2nd year's course in shops.—1. Forging, 30 hours per week for 8 weeks. 2. Foundry work, 30 hours per week for Second year

8 weeks. 3. Iron turning, 30 hours per week for 12 weeks. 4. Fitting (applied course), 30 hours per week for 12 weeks. In addition to the above, the student is at liberty, after the completion of the prescribed course, to make some small machine tool, such as a drilling machine, himself, from his own design, aided simply by the suggestions of the master, with the view of giving him independence in design and execution.

2nd year's course of theoretical instruction.—1. Machine drawing, 10 hours per week. 2. Freehand drawing, 4 hours. 3. Arithmetic, 2 hours. 4. Stereometry, 1 hour. 5. Applications of arithmetic and geometry to calculation of simple machine work, 3 hours. 6. Handling and protection of metals, 1 hour. 7. Theory of machine construction, 2 hours. 8. Book-keeping and commercial practice.

Workshop instruction.

Instruction in the workshops is founded, as at Moscow, on a progressive series of models which have been carefully selected for this purpose. Each student goes through the set course. The materials are provided free of charge by the school authorities, and all finished work belongs to them. The work of each student is kept together in a separate case, and any specimens of special excellence are drafted off to the school collections; the rest are sold at the expiration of two years. The Austrian Government has decided that, as far as possible, the new Fachschulen are to be schools of instruction only, and that manufacturing is to be avoided. All the practical work done in the shops will have a purely educational bearing. The schools are in fact to steer clear of competition with existing industries, and to avoid the introduction of the commercial element.

Other Austrian schools.

A similar school exists at Steyr, provided with the requisite workshops for teaching all the processes in the working of iron and steel, such as forging, turning, chipping, filing, boring, scraping, polishing, burnishing, welding, annealing, gilding, silvering, nickel-plating, engraving, etching, colouring, &c., including applications to wood, bone, horn, and ivory. Other schools for metal working have been established at Klagenfurt and at Ferlach, the latter for gun-making. We are indebted to Professor Hauffe, the director of the Technical High School of Vienna, for the prospectuses of these schools, which were not visited by the Commissioners.

Mechanical Engineering Schools in Holland.

Engineering school, Amsterdam.

Training School for Marine Engineers at Amsterdam.—This school was established by private enterprise, in consequence of the great need of skilled engineers in the merchant navy. The owners of steam vessels had to suffer grievous losses, due to the ignorance and incompetence of the men they engaged to take charge of the machinery on board ship, and they decided to found this school in order to train up a staff of men properly qualified to undertake these duties. The school is in receipt of a Government subsidy of 917*l.* per annum; the province

gives 166*l.*, and the town provides the school building rent-free. The director is Mr. J. W. Visser. The students' ages vary from 15 to 19. There are 92 students, and about 40 of them are boarded at the sailors' home, a short distance from the school. Owing to the want of proper accommodation, the students take it in turns to spend one day in the workshops and one in the school. Applications for admission to the school must be made each year to the director, during the month of June. The entrance examination is competitive, and takes place in the presence of a committee selected by the board of managers. The subjects are reading, writing, the elements of the Dutch, French, and English languages, the four rules of arithmetic, with vulgar and decimal fractions, plane geometry, algebra, and simple equations. Students who have a knowledge of drawing and smiths' work are preferred. Students, if necessary, are subjected to medical examination. The school fees are 8*l.* 6*s.* 8*d.* per annum, and for board 16*l.* 13*s.* 4*d.*

Subjects required for entrance examination.

Fees.

The course extends over two years. There is an examination at the end of each year, and a certificate of proficiency is given to those students who have acquitted themselves satisfactorily at the school, and subsequently spent one year in practical work on board ship or at a factory. For this purpose they return for a final examination. Places are found them by the school for the year of practical duty. No certificate is given for the school course alone. The school programme includes elementary geometry, algebra, arithmetic, mechanics and physics, theory of the steam engine, the theory of projection and perspective, the Dutch, French, and English languages, mechanical drawing, and smiths' work and fitting.

School programme.

The school is under the charge of the director, who takes the instruction in the theory of the steam engine. There are three other masters; a mechanical engineer in charge of the workshops, a skilled blacksmith, a fitter, and a turner. The students pass a year in the smithy and a year in the fitters' shop. They go through a set course of work in forging, fitting, filing, turning, &c. They have excellent machinery, including a steam engine, used solely for dissection as a means of study. The aim of the teaching, both in the school and the shop, is to give them a thorough practical acquaintance with the different parts of the machinery used in steam vessels, and the mode of repairing and making good accidents and defects. We went through the class rooms, and were shown some excellent machine drawing; the young men in the shops who seemed well-built, strong, young fellows, were working with a will, and the specimens of work we saw were of high quality, though of the nature of manual exercises rather than parts of real machines. Dr. Steyn Parvé informed us that the school had fully answered the expectations of its founders, and that the Government subsidy had been increased owing to its successful operation.

Staff of teachers.

Workshop instruction.

The Commissioners were greatly impressed with the value of the education given in this school, and with the economy with which the establishment was carried on.

Technical Schools for Mining and Metallurgy.

Continental schools for mining and metallurgy are of three grades.

The Continental schools for mining and metallurgy are of three grades. Of these, the highest, as the *École des Mines* of Paris, the *Berg-Academie* of Freiberg, those of Stockholm, and of Leoben in Styria, and the Prussian mining academies, rank with the great Polytechnic schools. Metallurgy is also taught in the Polytechnic schools. We shall speak of mining schools of the highest grade, later on, under the head of schools for higher technical instruction.

Mining Schools in France.

French mining schools of the second grade.

School of St. Etienne.

Next in rank to the above are schools like the *École des Mines*, or, as it was called till quite lately, the *École des Mineurs*, of St. Etienne, in the coal basin of the Loire. The change of name is significant, for it indicates that the students leaving the school occupy a higher industrial rank than that which appears to have been contemplated at the outset. The school is proud of having educated several distinguished engineers and men of science, M. Boussingault being one of the latter. It is a Government school under the direction of the Minister of Public Works, and it furnishes, in the first place, the Government sub-inspectors of mines, who, however, do not rise to the rank of chief inspectors, and second, sub-managers of mines and metallurgical establishments, some of these latter ultimately becoming managers of such undertakings.

Admission by competition.

The age of students on entrance is from 16 to 25 years. Admission to the school is by competition. There is a preliminary qualifying examination in each Department of France, and a subsequent competitive entrance examination of qualified candidates at the school itself. The examination includes the French language, arithmetic and logarithms, algebra, including the binomial theorem and the theory of logarithms, trigonometry, analytical, plane, solid, and descriptive geometry, physics, optics, and chemistry, more especially of the metalloids and metals, besides any other subjects which the candidate may select.

It will be evident from the subjects of examination that the school is not intended for working miners.

Course of instruction.

The instruction is gratuitous. It is given by three professors, and covers a course of three years, the school year beginning in October and ending in August. The first year's course comprises mathematics to differential calculus, theoretical mechanics and kinematics, physics, chemistry, mineralogy, geometry, and surveying. The second and third years' courses are on applied mechanics, mining, metallurgy, geology, building and machine construction, railways, mining legislation, and accounts.

The number of students varies from 80 to 90. The budget of the school is 2,000*l.*

Schools of the lowest grade.

The schools of the lowest grade are those for overmen and deputies of mines, of which there are two in France, one at Alais

in the south, and one quite recently established at Douai, in the northern coal basin; and a large number in Germany, more especially in Prussia, the earliest of the German schools dating back to the last century, and an interesting example being the one established in 1793 at Steben by Alexander von Humboldt, then 24 years of age and mining engineer of the Franconian Principalities. It will be convenient to include under the same head the metallurgical school established in 1882 for foremen and leading hands of iron and steel works, and for foremen engineers, at Bochum, in Westphalia.

Mining school at Douai.

The school at Douai (*École des Maîtres Mineurs*), which is a Government institution, contains 35 pupils (20 in 1883). The instruction is gratuitous, the cost of each student's board is 20*l.* per annum, and nearly all the students are maintained by "Bourses," or scholarships, of which four are given by the town, four each by the Départements du Nord and of the Pas de Calais, and the remainder by the colliery owners of the district. All of them are working miners, generally selected by the coal proprietors. The instruction, of which we give the programme in the Appendix, and which is eminently practical, alternates, from three months to three months, with work in the mines, and extends over two years. At the time of our visit it had not been established long enough for any judgment to be formed of its results. The budget of the school is 946*l.*, of which the payments to the teaching staff amount to 532*l.*

Mining Schools in Germany.

Mining schools in Prussia.

In Prussia there are 11 schools for miners, containing altogether between four and five hundred students. Several of them have a group of preparatory schools, in the district of which they are the centres, affiliated to them.

Preparatory schools connected with Bochum school.

Thus the *Bergschule of Bochum* has 10 preparatory schools, one with about 30 students in the town itself, and 9 others in the neighbouring towns and pit villages, with about 220 students, all of them pitmen, or employed about the pits in some capacity. The instruction in these preparatory schools is given on the evenings of four working days, except drawing, which is taught on Sunday mornings; the course occupies two years; the subjects are the German language, arithmetic, drawing, elementary physics, and in the last half year explanations of the rationale of mine regulations. At these preparatory schools the miners may acquire sufficient elementary knowledge to be able to profit by the instruction in the mining school proper.

Students in mining schools must have been actually engaged as miners.

The regulations of nearly all the German mining schools require that the students shall have been actually employed as workmen in mines before they can enter the school. The Saarbrück school demands the minimum in this respect, namely, a full year's work as a pitman. The requirements are greatest

at Bochum. The rule there is that candidates must have worked four complete years in the pit; they must produce certificates that they are industrious and skilful, and that their conduct is reputable. The minimum age of admission varies in different schools from 17 to 21. There is no maximum age. In practice, the students in the schools are generally from 20 to 25 years of age. The candidates have to satisfy the examiners that they can read fluently, write legibly and correctly, and are conversant with the four rules of arithmetic. Some of the schools also require some elementary mathematics and physics, and more or less of drawing, the minimum being ability to make an outline drawing of the usual mining tools. The schools are generally held in Government or municipal buildings, and the cost of instruction is defrayed out of a general fund subscribed by the mine owners. That of the school at Bochum is about 1,500*l.* per annum, and of its preparatory schools about 600*l.*

Ages of students.

Mining school at Bochum.

The Bochum school has a lower and an upper division; the former is a half-time school, the students continuing to work in the mines half the day. The instruction in this division occupies two years. It includes mathematics, mining, mechanics, drawing, and natural science (physics and chemistry).

Upper division has two departments.

The upper division occupies one year, and the students do not work in the mines. It has two departments, one for mine surveying, the other for mining proper. The subjects taught in the former are mathematics, surveying, geology, mine accounts, mining law, and the German language. Those taught in the latter department are mathematics, mechanics, geology, machine drawing, surveying, and mining. It may be mentioned that, in connection with the laboratory of this school, a separate building has recently been erected for carrying on researches by a Government Commission on explosive gases, and the conditions of their presence and explosion in mines. The Bochum school was not in operation when we visited it, on account of the Whitsuntide holidays, but some notion may be formed of the scope of the instruction from that given in another mining school, that of Zwickau, in Saxony, in which German includes essays on mining operations; mathematics includes quadratic equations and logarithms, geometry, proportions, and elementary solid geometry; physics and mechanics include the properties of liquids and gases, with special practical applications, electricity and magnetism, and practical exercises in the theory of falling bodies, the mechanical powers, &c.; mineralogy and chemistry include crystallography, the minerals found in the coal measures, and the principal ores of the metals; mining includes faults, sinking, and boring, all branches of the working, drainage, and ventilation of mines, and the preparation of minerals at bank, &c.; and the instruction in machine construction, drawing, &c., is of a similar practical kind.

Course of instruction in lower mining schools of Germany.

About one-fifth of the students of the Bochum Mining School ultimately rise to the position of mining engineers, or mine managers, and a few to that of managing directors of mines.

The Rheinisch-Westfälische Hüttenschule, Bochum. — The necessity which was felt by the iron and steel manufacturers of Rhineland and Westphalia that their foremen and leading hands should possess some theoretical knowledge in addition to their practical workshop experience, and the satisfactory results of the establishment of mining schools in that district and elsewhere, have led to the creation at Bochum of a metallurgical school on the lines of the mining school of that town. With the exception of the mining schools, this is the only Continental school having a complete course of instruction, to which only workmen who have already had regular workshop training are admitted, the candidates being required, as in the case of the mining school, to have worked at least four years in iron or mechanical engineering works before they are admitted. Certificates of competence and good conduct, and satisfactory proof of elementary knowledge, including drawing, are also demanded, as for the mining school. Indeed, the regulations generally resemble those of that school, with the exception that the whole time is occupied with the work of the school, employment in the works being, for the time, given up. It is a municipal school, held in buildings formerly occupied by a Real—or, as it was called,—a Gewerbeschule. The Government has undertaken to continue the subvention of 700*l.* per annum which it paid to the former school, the town and the manufacturers contribute the rest; the latter body undertaking the maintenance of all or nearly all of the students. The course occupies three half-years; the first being preparatory and general, the following two special, in two divisions; one for metallurgy, and the other for machine construction. The teaching staff consists at present of a director who is a chief engineer of ironworks, together with a teacher of machine construction and drawing, one for mathematics and mechanics, one for physics and chemistry, and an assistant master for the German language and accounts. No class is to contain more than 40 students; should this number be exceeded, parallel classes under proper teachers will be formed. Representatives of the contributing iron trades take part with those of the Government and the town in the management of the school.

Reasons for establishment of metallurgical school at Bochum.

Course of study.

The time table is as follows:—

In the Preparatory Class:

Drawing	6	hours	weekly.
Arithmetic and Mathematics	8	„	„
Physics	5	„	„
Experimental Chemistry	6	„	„
The General Principles of the Metallurgy of Iron and Steel	7	„	„
German and Business Accounts	4	„	„

In the Metallurgical Division:

Drawing	6 hours.
Mathematics	4 „
Physics	4 „
Chemistry and Laboratory Work	10 „
Special Metallurgy of Iron and Steel	12 „
German, &c.	2 „

In the Division for Machine Construction:

Mathematics	6 hours.
Mechanics	6 „
Machine Construction and Drawing	18 „
Physics	4 „
German, &c.	2 „

Nature of the instruction.

The teaching is as practical as that of the Mining School. Without entering too much into detail, we may state that in the Metallurgical Division no subject connected with the construction and management of blast furnaces and their appurtenances, with the practice of moulding and ironfounding, the puddling, refining, and finishing of iron, the production and working of steel, the analysis of the raw materials, or the testing of the finished products, is omitted; and that the course for Machine Construction includes all, but no more than, the mathematics which every mechanical engineer should know, and further, instruction in theoretical and applied mechanics, in the properties of the materials ordinarily used in machinery, in the construction and necessary qualities of the elements of machines, as screws, rivets, axles, toothed gearing, cylinders, pistons, valves, &c., and in the construction of various complete machines, including lifting tackle of every kind, boilers, steam engines, water and gas motors, and in the economy of the workshop. Visits are paid to the surrounding works,—36 important ironworks, engine factories, and other works, having been visited by the students during the 15 months preceding the last, which was also the first, Report.

Students.

The age of the students, of whom there are 56, varied on entry from 18 to 34 years. They comprise 4 moulders, 1 puddler, 1 steel worker, 3 rollers, 1 erector, 3 smiths, 35 fitters, 3 turners, 1 boiler maker, and 4 pattern makers.

The cost of instruction is 10*s.* per term, or 1*l.* 10*s.* for the entire course.

The laboratories and libraries are fairly complete, and are daily receiving accessions.

Importance of this school with reference to the establishment of similar schools in England.

We have thought it desirable to enter into rather more particulars in regard to this school than in reference to some others, as it is the first example of its kind, and one the working of which should be carefully watched by our own metallurgists and engineers.

(2.)—CONTINENTAL WEAVING SCHOOLS.

Introduction.—Among the special technical schools having a direct bearing upon industry, we found, in every country that we have visited, a number of weaving schools. Some of these are separate and complete institutions for the teaching of spinning, designing, weaving, and dyeing, receiving pecuniary assistance from public and other sources, and controlled in some measure by the manufacturers of the localities where they are situated, whilst others are simply departments of general technical schools in which designing and weaving are taught among other branches of technical instruction. We have arranged these schools under the headings of the different countries, and have selected types of the best schools for special description.* We visited one school only in which spinning was being systematically taught by a complete set of machines, namely, the School of Spinning and Weaving at Mulhouse. At the Vienna weaving school we were shown a plot of land attached to the weaving department, on which a spinning shed was about to be erected, and we were informed that complete preparations of machinery both for the spinning of cotton and wool had been promised by leading English machine makers.

Introduction to Continental Weaving schools.

Before proceeding to describe any of these Continental schools in detail, it may be desirable to point out their general aims as gathered from our visits to the schools, and from conversations with their promoters in different countries. They are intended to teach whatever the master, the foreman, or the designer, ought to know in connection with his trade; but they propose further to give a thorough knowledge of textiles and their construction to merchants, agents, distributors, and shopkeepers. The schools are not intended to supersede apprenticeship in the factory, but rather to convey knowledge which is not to be obtained in other than very exceptional factories; while to merchants and others they supply the practical all-round knowledge which otherwise could only be obtained with great difficulty.

General aim of weaving schools.

Not intended to supersede factory apprenticeship.

As a mere training place for weaving, it is admitted that the factory possesses considerable advantages over any conceivable school. It is worked for profit; there must be no idlers among the responsible officials or workers; everything is practical and subjected to the stimulus of lively competition; and the man taught there learns real business; nothing conjectural, or antiquated, or needlessly refined. On the other

Advantages of factory over school training.

* For readers desiring additional information upon weaving schools, we recommend a perusal of the "Report to the Worshipful Clothworkers' Company of London on the Weaving and other Technical Schools of the Continent," by Walter S. B. McLaren, M.A., of Keighley, and John Beaumont, Instructor in the Textile Industries Department of the Yorkshire College, Leeds. (Publishers, Rivingtons, London, 1877.).

hand, the school is apt to be encumbered with old machinery and old processes; its directors are not likely to have been lately working for wages, or to have a very keen eye for the changes of recent date, or as yet only imminent; they may be more inclined to teach what is easily taught than what is most useful; forgetting that the subject is so intensely practical that it must be learned under the most effective conditions if it is to be learned at all.

Schools valuable to future manufacturers.

A good school, however, in some important respects possesses advantages over the factory. The instruction of the young apprentice in the factory is often of the most routine kind, just enough to enable him to do the work in hand. Why the loom is made and worked in a certain way, there is no time to explain, and it is no one's duty to convey the explanation. It is only in the leisure of the school that the instructor can deal with such things, and explain not only what is being done, but why it can be done better thus than otherwise. In the factory or workshop, where time is exceedingly valuable, every man is kept to what he knows best The weaver changes the shuttle as the spool is emptied, and watches all day long the loom going through the same operations thousands of times, doing this not for his own improvement, but for his wages and his master's profit.

For the young man who aims at directing weavers, rather than at becoming a weaver himself, something less than this would suffice. Competent practical skill for his purpose may be gained in a short time, and then his attention can be better bestowed upon new operations. A certain width of range is more important to the intended master or foreman than great manual dexterity, and for this the school is more effective than the factory. A single factory, especially if it be small and remote, cannot include a whole industry, but merely some small part of it. Thus, in England, where the organised industries are looked upon as examples for imitation by the whole world, a county may have one leading industry; a town its own special branch of that industry; and a mill one single operation of that special branch. The cotton industry of Lancashire is subdivided to a degree unknown elsewhere; the representatives of all the departments meeting almost daily in Manchester for the transaction of business and mutual interchange of ideas. Yorkshire is concerned with wool, and hardly meddles with cotton. Bradford deals mainly with worsted, Leeds with woollens. A particular mill in Bradford may be exclusively engaged in wool-combing; another in spinning one or two counts of yarn; a third in weaving one class of goods only. The apprentice may learn all that is to be learned in one of these factories, and yet may know little of the worsted manufacture; he may even know what is done in them all, and yet have an experience too narrow for a general knowledge of textiles or for the direction of a manufacturing establishment. Again, there are things not taught in any factory, and hardly to

Industries special to particular places.

be acquired by the man who is earning his daily bread, which may nevertheless be of vital importance to the man of business whose personal aim it is, not to execute more and more swiftly some constantly repeated operation, but to find out what the world wants, and how that want can best be met. We know what this means where an industry has a scientific basis. The Polytechnic, and other more purely technical schools visited by the Commissioners, have illustrated to us very distinctly what a knowledge of chemistry does for the ironmaster or colour manufacturer; what a scientific knowledge of electricity does for artificial lighting; how the mining engineer and the civil engineer are assisted by a knowledge of geology, mechanics and hydraulics. Weaving has, it is true, no such scientific basis, but weaving (none the less) is all the better for a culture which is not afforded by any single factory. Fashions can be set, or they may be followed, and the student will find in his industrial experience how capricious and changeable they are, but experience will also teach him that whoever can satisfy the prevailing taste is sure of customers, and excellence in this respect stands on the same level with good wearing quality and low price. Moreover, this is the variable element; the quality with which calculation and experience of factory management have least to do; the one in which force and versatility carry all before them.

As is the case in other branches of industry; in pottery and porcelain, glass, furniture, and metal work, where the higher qualities of design and artistic workmanship have developed trade and brought wealth to the producers, so in textile industry it is the design that sells the cloth. The quality of the fabric may be hard to tell, but every customer forms his own estimate of the pattern printed upon it, or woven into it. The wool-comber, the spinner, the weaver, may each do his part faultlessly, but if the design is unsatisfactory or inappropriate, or the colour or finishing of the piece ineffective, it will be cast aside by the purchaser as inferior the moment it is displayed on the shop counter against more effective, even though intrinsically less valuable, goods. False work, it is true, will not be permanently tolerated even under the disguise of "fair seeming," but it is folly in a manufacturer to neglect excellence in that department of his work where it tells most and costs least.

Design of goods causes sale.

It is required of the school that it should give a general acquaintance with various kinds of machinery and with a number of different processes, of which very few are ever worked together, but the chief advantage of such a school lies in the possibility which it affords of artistic training. The design, and the working out of the design—so that what appears on paper may appear also on the woven fabric—are the chief ends of the weaving school; in fact, such an institution might appropriately be called "a school of art applied to weaving."

There are some students whose natural gifts incline them to mechanism, others whose capacities impel them towards art, but the artists are taught some mechanism, and the mechanics

some art. The student of textiles is taught to draw, to combine, to adapt; he is instructed in harmonious colouring; his taste is cultivated by choice examples of what is good in fine art, as well as in industrial art; he learns to translate his designs into woven fabrics, to become ready with all the calculations of the loom, and he is made familiar with those mechanical and commercial considerations which make the manufacturer's goods successful when presented to the buyer.

Weaving Schools of France.

Lyons Weaving School.

The *École Commerciale, Lyons* is probably the most complete though not the most numerously attended of the weaving schools of France. It is situated in the Rue de la Charité, and was visited by the Commissioners in November 1881. It is a department of the Commercial school, which was created in 1872 by a joint committee of Lyons manufacturers, consisting of 300 to 400 members, and including subscribers from St. Etienne and the surrounding district. The share capital amounts to 44,800*l.*, of which only three-fifths has been called up.

School, how divided.

The school consists of two divisions, a commercial school proper, the fee for which is 24*l.* per annum, and a weaving school, the fee for which is 48*l.* per annum. For 88*l.* and 112*l.* per annum, respectively, the students of the two departments are likewise lodged and boarded. The State, the city of Lyons, and the Chamber of Commerce, each give a small number (five or six) exhibitions for poor students.

No. of students.

In the whole school there are 72 students, 20 being in the preparatory department; 30 of these are boarders. The number of students in the weaving school is 12. The term lasts from the beginning of October to the first week in August.

The weaving school alone was visited by the Commissioners. This was established about five years ago, and is carried on in a separate building, three storeys high; there are 14 looms, capable of doing 23 different kinds of work, as Taffeta, Foulard, Façonné, &c. There are two expensive tulle looms, not in use at present, and looms for weaving ribbons and velvets. Most of these looms have either been given by manufacturers or have been supplied at a reduced rate. The machinery is driven by a two horse-power gas engine.

We were shown a portrait of M. Thiers, woven in silk, in one of the looms, taking 2,000 hooks and 8,000 cards to weave it.

Supplied with good models.

The school is also supplied with good models of spinning machinery. The professor of weaving is M. Loir, and the students work under the superintendence of a practical foreman. They have four hours' theoretical teaching and four hours' practical work each day. The students here are chiefly the sons of manufacturers, and included two Englishmen, both of whom expressed

themselves well satisfied with the course of instruction they were pursuing, and believed that it would be of the greatest service to them. They expected, at the end of 12 months, to be able to put on the loom any pattern that might be given them, and were occupied at the same time with designing on a systematic plan.

The students in this department are able, at the end of three months, to produce paying work. The weaving department is worked at an annual loss of 120*l.* to the school, caused mainly by the expensive material used in the looms—the total losses, from the commencement, amounting to 2,440*l.*

Director of school.

The director of the school, M. Pénot, was formerly the director of a similar school (including a dyeing school) at Mulhouse. This post he had held for 33 years, but he left in 1872, in consequence of the results of the war, and was invited by the Chamber of Commerce to establish a similar school to that of Mulhouse at Lyons. This gentleman gave the Commissioners a considerable amount of information respecting the working of this and the Mulhouse school. He remarked that a systematic microscopic examination of the silk-worm, and of the eggs, was now being made by the pupils for the purpose of detecting the disease and applying the tests prescribed by Pasteur for this purpose. He also stated that at the dyeing school at Mulhouse all the more important chemical compounds employed in the trade were manufactured by the pupils, that commercial samples were tested for impurities, and that the actual value of the various colouring matters was determined. By way of illustration, he described how the students determined the commercial values of various samples of indigo, by directly comparing their dyeing power with that of indigo of known purity.

M. Pénot, who is a gentleman 80 years of age, stated it to be his intention to establish here a school of dyeing similar to that which he had so long superintended in Mulhouse. He desired, however, first to secure the commercial and weaving schools on a firm basis.

The budget of this school will be found in the Appendix, Vol. V.

Free lectures.

Popular Lectures on Designing and Weaving.—Courses of free lectures on weaving and designing are given by the professors of the above school to artisans and others. A Sunday lecture by M. Loir, the professor of weaving—one of a series extending through the winter months—was attended by the Commissioners. The lecture was of a technical character, thoroughly practical, and dealing with the problems daily brought before the hand-loom weaver and loom "tuner." The audience consisted of about 100 workmen, most of whom took notes, and copied in their books the calculations and diagrams, made by the lecturer on the blackboard, as he proceeded with his lecture.

École de Dessin.

Weaving School, St. Etienne.—The Commissioners also visited at St. Etienne the very important *École de Dessin*, to which is attached a school of weaving and pattern designing. The hours of instruction are from 1 to 4 in the afternoon and from 8 to 10 in the evening. The school is fitted with very large drawing-rooms, in which the pupils were engaged in drawing from the antique. There are also rooms for drawing from the life, which forms an important part of the instruction, and good rooms for modelling in clay and working from the antique. The school has an excellent winter garden, so that the pupils may have the opportunity of drawing from living plants throughout the year.

The art instruction is given principally with a view to the training of practical designers for the silk industry.

Designing; method of teaching.

In the same building there is a lecture room in which pattern designing is practically taught. The patterns are exhibited and illustrated by means of a honey-combed blackboard, into the cells of which small cubes are fitted, each of the faces being differently coloured. Attached to this lecture room is a small weaving shed, in which there are several model hand looms, on which the patterns exhibited on the blackboard can be produced, and which are also used for explaining to the pupils the construction of the machine. No saleable work, however, is produced on these looms. The professor stated that one of the advantages of having these looms in the school is that the workmen are able to receive explanations from himself of any difficulty which may occur to them in their daily work.

No. of pupils.

At the time of the Commissioners' visit there were about 350 pupils in attendance at the evening school of design, of whom over 40 attended the weaving school.

School appreciated by workmen and foremen.

The advantages of the school are greatly appreciated by the foremen and workmen of the town, but the director complained that too little interest was shown in its progress by the manufacturers of the district. He did not, however, ascribe this to any want of appreciation of the advantages of such technical instruction, but rather to political considerations which at that time were tending to separate somewhat the workpeople from the manufacturers.

Is municipal.

The school is a municipal one, and M. Peyroy is the Chairman of the Committee of Fine Arts in the Municipal Council. The school is supported by an annual vote of 1,200*l.* from the Town Council. The Chamber of Commerce and a few manufacturers give prizes.

Other schools visited.

The following weaving schools of France were also visited by the Commissioners, namely, the weaving departments of the Professional Schools of Lille, Rheims, and Rouen, the Industrial School of Rheims, the weaving school at Nismes, and the weaving and dyeing school at Roubaix. The latter school is shortly to be superseded by a new building for designing, weaving, and dyeing, to be erected at a cost of 80,000*l.* There are no specialities in any of the above schools which are not included in the schools selected for more detailed description.

Weaving Schools of Belgium.

Much has been said about the numerous industrial and weaving schools of Flanders. These schools were established about the years 1847–8, when the hand-loom weavers of linens in the country districts suffered great distress, owing to the introduction of power looms and the building of factories. The object of the Government in promoting the schools was to introduce new fabrics and new designs of too intricate a character to be woven at that time on power looms. The schools were useful during the transition period, and many of them still exist in Flanders, but on a very small scale. Such fabrics and patterns as were monopolised by these hand-looms are now produced on power looms without the aid of these schools, although to some of them employment is still furnished, as a commercial undertaking, by small master weavers. At the office of M. Rambaud, the Minister of Industry and Agriculture, we saw samples of weaving, in various styles and materials, from 45 of these schools. The hand-loom weaving of linen goods is, at the best, stationary in Belgium, whilst the manufacture of linens by power is an important and flourishing industry. The more important weaving schools visited by the Commissioners in Belgium were those of Ghent and Verviers.

Weaving Schools, Belgium.

Object of formation.

Other schools visited.

Industrial School, Ghent.—Weaving Department.—The Industrial School of Ghent, which has been elsewhere described, is divided into four sections, namely, (1) courses for workmen in literary and scientific subjects and drawing, held on Sundays and on Monday evenings; (2) higher courses in similar subjects for foremen, clerks, and sons of employers, &c.; (3) apprenticeship school for weaving, for foremen and directors of weaving factories of all kinds; (4) special industrial art school for the application of art to the purposes of industrial design. This school is justly considered to be one of the best technical schools in Belgium. It is attended by over 1,000 students, and all the departments are free. The expenses are met by grants—two-thirds from the State, one-third from the town, and a small extra grant from the province, the total being upwards of 2,000*l.* annually.

Ghent Industrial School.

How divided.

No. of students.

Instruction gratuitous.

The weaving department is conducted in a shed containing about a dozen hand-looms and about half-a-dozen power looms, the latter being mostly of English make. We saw winding and warping frames and such other machines as are considered useful for teaching purposes. There are 10 students, the majority of whom are the sons of local employers. Two were said to be from Germany and one from Switzerland. As in the Vienna and Crefeld schools, drawing is taught in the art department with special application to textiles of all kinds; but we did not ascertain that the study of pure designing forms a portion of the course for the weaving students, and we did not see among the many admirable designs submitted to our inspection any intended for textile purposes.

Weaving department.

No. of students.

Operatives do not attend weaving school.

The instructor of weaving expressed regret that operatives do not attend his classes. He admitted that it is impossible for them to do so in the daytime, because they cannot forego their wages. They are not able to attend night classes until eight o'clock at the earliest, after working in a factory for 12 hours, and very few have strength or zeal enough for such sacrifices. He is endeavouring to establish bursaries by which employers or others will recoup the students for loss of wages while attending the classes. There appeared to be less spirit and activity displayed in this than in most of the other departments of this useful school.

Professional School, Verviers.

Professional School, Verviers.— Weaving and Dyeing Departments.—The weaving and dyeing schools form departments of this excellent institution, which was built by the town at a cost of 20,000*l.* The school is maintained, one-third by the town and two-thirds by the State, the total annual grants amounting to upwards of 2,645*l.* There are 300 students in the several departments, who are admitted to all the privileges gratuitously.

Instruction is free.

New school to be built.

A new school, called l'Ecole Manufacturière, is to be built for the further promotion of the textile industries. It will cost from 20,000*l.* to 24,000*l.*, towards which the employers in Verviers have promised 6,000*l.* The projected budget of maintenance submitted to the Municipality shows an annual expenditure of 1,911*l.* from public sources for this school alone. It would be difficult to furnish stronger evidence of popular belief in the utility of schools of this character than the willingness of ratepayers and taxpayers to give such generous support. In the weaving school we counted 12 handlooms with jacquards and motions for fancy weaving. In one very large jacquard loom a life-size portrait of the King of the Belgians was being woven.

Weaving department.

In the chemical laboratory there are places for 24 students, and in the dyeing school there are 10 students, being the full number for whom there are places.

Weaving School of Switzerland.

Wipkingen, Zurich. Silk-weaving school.

Weaving School, Zurich.—The only weaving school in Switzerland visited by the Commissioners, and probably the only school of this kind in the Confederation equipped as a separate institution, is the silk-weaving school at Wipkingen, Zurich. At the time of our visit in May 1882, it had only been open about six months. The school building was originally a large private house, and, we were informed, was purchased by the town, and converted to its present use at a cost of 2,600*l.* Towards this sum the Silk Industry Society contributed 1,400*l.*, and an additional 800*l.* for furniture and machinery.

Looms run by water-power.

The room for power looms is about 45 to 50 feet square; the motive power is supplied from the town turbines situated on the bank of the river Limmat, near the school. Among the hand-

looms are 10 from Lyons, 2 from Zurich, and two jacquards. Other jacquards had been ordered on the Lyons, Crefeld, and Zurich systems of silk weaving. A velvet loom is shortly to be added. The class-rooms are well arranged and substantially furnished with oak desks and tables. The museum contains six large exhibition cases, to be filled with specimen collections of silk fabrics, cocoons from all parts, and illustrations of silk culture. Museum.

There is accommodation for 45 students. At the time of our visit, 22 had joined the school. Many come either direct from the secondary school at the age of 16, or after a few practical lessons in weaving at a factory or cottage loom. A few students have been one or two years in business. The fees are, for cantonal pupils, 8*l.* the first year; 12*l.* the second year; or 16*l.* for the course of two years. Strangers pay 12*l.* the first and 20*l.* the second year. No. of students. Fees.

The students are taught the distinctive methods of silk weaving adopted in France, Germany, and Switzerland. The head-master has gone through the Lyons course, and has worked in a factory. His method is founded somewhat on that of Lyons. He has one assistant. Method of teaching.

We were informed that the Silk Industry Society, which is the patron of the school, is composed of merchants and manufacturers who co-operate in all undertakings that tend to promote their industry. During recent years this industry has made rapid advances, and is now nearly equal in importance to that of cotton, which has long been successfully established in Switzerland. Silk Industry Society.

Weaving Schools of Germany.

The weaving schools of Germany are among the best of their kind that we have seen. We select for description three which fairly represent the best types of these schools in different States, and differ from each other in important aspects. The first is the spinning and weaving school of Mulhouse, which is especially interesting as the best illustration that we have seen of instruction in cotton spinning, while it is also complete in appliances for power-loom weaving and possesses an extensive variety of looms from the best makers in competing countries. The second is the higher weaving school of Chemnitz, which has long enjoyed a favourable reputation in this country as well as in Saxony, the sons of some of the largest manufacturers in England having been educated there. The Chemnitz school is one of the best examples of a school for teaching the application of designs to the loom, and for varied instruction in the weaving of many kinds of fabrics by hand and power looms. The third school, which we would desire particularly to bring under the notice of the textile communities in England, is the new school for the textile industry at Crefeld, which has recently been erected at a cost, including land, of 42,500*l.* Of all schools we visited for teaching designing, the Weaving schools, Germany.

application of the design to the loom, the manual operations of weaving in the best makes of hand and power looms, and the dyeing and finishing of manufactured goods, this school is the most complete and the most important.

School for spinning and weaving, Mulhouse.

School for Spinning and Weaving, Mulhouse.—The school at Mulhouse is favourably situated for meeting the wants of a wide and important manufacturing district. The population of the town is upwards of 64,000, engaged in varied textile and mechanical operations, but there are also many towns and villages throughout the whole province of Alsace, of which Mulhouse is the centre, where textile industries are vigorously conducted. In close proximity are factories and machine making establishments, and but a short distance from the school are the museum of textile fabrics and the school of chemistry, with both of which it is intimately allied through its dependence upon the Industrial Society of the town. This is the only school which we saw or heard of, in which spinning is taught by a complete set of machines.

Museum of textiles.

School of chemistry.

When established.

The weaving department of the school was founded in 1861; that for spinning in 1865, and the two were united in 1869.

Built by shares.

The capital was subscribed by the leading manufacturers, machine makers, and merchants of the neighbourhood, in shares of 1,000 francs each (40*l.*), making a total of 120,000 francs (4,800*l.*). These gentlemen, and the council of the Industrial Society, are responsible for that part of the expenditure which is not covered by school fees and ordinary subscriptions.

Not a State Institution.

Unlike all other Continental technical schools that we saw, neither the State nor the municipality contributes to its maintenance.

Management.

The school is managed by a council of nine members, chosen by the subscribers and shareholders from the leading industrial and commercial firms in the province.

Buildings.

The buildings are neat and substantial, the main portion being two storeys high.

Machinery.

The ground floor contains a large room for mechanical weaving with power-looms, another large room for design and theory, and rooms for the council and headmaster. Connected with the room for power-looms is a shed sufficiently large to contain a preparation of cotton carding and drawing, some mechanical models, looms for "setting up" and "taking down," &c.; so that students may become familiar with every part of the machine. Adjoining the shed is a boiler-house and a 12 horse-power condensing steam engine. The upper storey of the main building contains a spinning department with self-acting cotton mules fully equipped, and a number of rooms for the residence of the director. The spinning machinery has been supplied by the principal makers in England and Alsace, and engagements have been made with machine makers to supply the school with new models and copies of the most recent inventions, from time to

time, as they are introduced to the trade. There are models of knitting and other miscellaneous textile machines. In the weaving department we counted 24 power-looms, mostly by English makers.

Teaching.

The director, M. Emil Fries, is in charge of the whole school, the departments of which are managed by assistants, each competent in the theory and practice of his particular branch.

Number of students and fees.

At the time of our visit there were 43 students in the school. The fees for the theoretical and practical courses, including both spinning and weaving, are 28*l.* for a year of ten months. For theoretical instruction only, in the two branches, 18*l.* a year; for practical instruction only, 20*l.* a year. Those who have followed either course can take up the other on a payment of 12*l.* Foreigners are admitted on the same terms as Alsatians; the minimum age of entrance is 16. There are no boarders, but the prospectus states that suitable lodgings may be obtained in the town at 2*l.* 15*s.* per month. Examinations are held at the close of each year, and certificates of capacity are granted according to degrees of merit.

Status of students and nationality.

The students are almost entirely of the richer classes, sons of merchants and manufacturers, or, as not unfrequently happens, the sons of wealthy men from a distance, themselves unconnected with textile industries, but anxious that their sons should learn manufacturing. It was frequently represented to us that there is a great objection among German manufacturers to teaching their particular trades to the sons of capitalists not in trade. The bulk of the students come from Alsace and France, and a fair number from Switzerland. There are very few Germans who are not Alsatians. Last year there was an English student, and since the establishment of the school there have been six from England. Most of the students, on finishing their instruction, particularly if they cannot enter a local factory on favourable terms, come to England for the purpose of completing their practical education in English factories, or with the hope of taking situations as designers or clerks.

English students.

Spinning: Theoretical course.

For *cotton spinning* a theoretical course is given simultaneously with the practical. Students are instructed in the cotton plant and cotton fibre, the conditions of growth, the treatment of the fibre, and the machinery required for producing various kinds of yarn. In this department all the calculations relating to the expenses of spinning are taught; the cost in coal, depreciation of machinery, the losses from waste, &c., so that the student can ascertain the margin between the cost of the raw cotton and the cost of the finished yarn.

The course also includes the commercial branches, brokerage, shipment, the customs of the trade, systems of payment at distant markets, and the incidence of import and export duties.

Cotton spinning:

For the practical teaching of cotton spinning the department is furnished with all the appliances of an actual factory. The

Practical course.

cotton is unpacked from the bale and goes through the operations of cleaning, carding, drawing, roving and spinning, by mule, ring, and throstle processes. For these purposes the most modern machines are used, the greater number being of English make. We saw the machinery at work, and the cotton yarn being produced. The students were attired in blouses such as are worn by factory operatives, and under the supervision of a practical foreman they "minded" the machines, many of them showing the greatest dexterity in "piecing" the ends or threads and conducting some of the detailed operations. Each student begins at the beginning, and, following the course of the raw material, learns the use of every machine and the calculations required for all necessary changes in the production of varied kinds and counts of yarn. The raw cotton is bought by the council of the school, and includes the recognised qualities from America, Egypt, India, and other sources of supply, so that the student may become acquainted with the characteristics of each in the working. The yarn is disposed of by the council, in the town or neighbourhood.

Effect of instruction.

This theoretical and practical teaching is supposed to enable a student to learn all the practical manipulations connected with cotton spinning without entering a factory, and without the ordinary apprenticeship in a counting house. After a two years' course he enters upon the duties of either with a *general* knowledge of the work of both. Whether this be the case or not, a painstaking and diligent student, by this method, will make very much better use of his time than the ordinary apprentice in a factory, and may in effect shorten his term of apprenticeship by much more than the time occupied by the school courses. In this school the student finds a variety of applications such as can only be seen in the largest and most complete establishments; and it must always be remembered that, in scattered districts and outside England, such factories are very few. Side by side are English and foreign machines of the best and newest kinds. The various methods of twisting and winding, the systems of ring and mule spinning and twisting, with the most recent improvements, are either taught practically or explained. We noted, for example, that electrical appliances for stopping some of the machines were in use, and the principles of electricity as a controlling power were thus brought under the notice of the students.

Electricity used.

Weaving department: Theoretical course.

The *weaving department* of the school, like that of spinning, is divided into the theoretical and the practical divisions.

The theoretical division embraces the whole theory of manufacture, the uses of various materials, the cost of the processes, the analysis of every kind of cloth and fabric, and the special study of such tissues as are adapted to the manufactures of the district. Each student is required to "decompose" patterns, to separate the warp and weft, specifying the material, qualities, counts, &c., all of which are duly entered, and the design is

copied on point paper. The specifications are then worked out, the calculations made, and the pattern, if necessary, built up again. The student is also required to devote a portion of his time to copying designs on paper. The adaptations of pictorial design to woven patterns are carefully taught, so that the face of a design may be put upon the cloth with the simplest appliances. The theory of the harmony of colour and outline is taught. As in the course for spinning, the commercial branches of the textile industries are also taught in class.

Weaving: Practical course.

The practical division of the weaving department supplies instruction in the weaving of all kinds of textiles in actual power-looms. The looms, of which we counted 24 in one room, represent all the important styles and makes which are in use for the weaving of silk, wool, cotton, linen, and jute. We saw all these materials in work, and in some of the looms there were combinations of several materials. The great majority of the looms were English, the makers of Lancashire and Yorkshire being well represented. The students were attired in blouses as in the spinning department, and were superintended by a competent overlooker. He was assisted by a practical weaver, a girl, who was said to be very useful in repairing serious breakages, and helping students out of their difficulties. It is well understood that under the control of inexperienced "hands" the power-loom is a machine that is capable of doing considerable mischief. A single false stroke of the shuttle often causes breakages in the warp which only an experienced weaver can repair.

Methods of study.

The student is taught how to manage an ordinary loom, tying knots in the warp, &c., in a power-loom of a plain and simple character, minded by a more advanced student. Having made a design for a fabric, he subsequently prepares the warp, cuts the cards if it be a fancy cloth, arranges the jacquards or the harness necessary for weaving the pattern, and starts the loom. He continues weaving at the loom until he has produced satisfactory work. He then changes places with another, who has in a similar way fixed a different design in another loom. This method is continued throughout the establishment, and each student has the advantage of learning to weave not only his own patterns, but also those originated and placed in the looms by his colleagues.

The system to some extent prevents waste of material, but it seems rather to encourage the weaving of long webs, and thus tends to keep the students longer at each pattern than is necessary for the mastery of its details.

Woven fabrics how disposed of.

The woven fabrics are sold to manufacturers and merchants, and when the designs are successful commercially, as not unfrequently happens, the students are allowed to obtain the advantages of their success.

Evening classes were not successful.

There are no evening classes. We were informed that a few years ago an attempt was made to extend the advantages of

the school to artizans in daily employment. Many practical weavers joined the classes, but after a short time neither the attendance nor the spirit could be kept up. The workmen alleged that after their day's work at the factory (11 hours) they had neither strength nor disposition for new work at a school. The evening classes were therefore given up, and have not since been re-opened.

Influence of the school.

With regard to the influence of the school, one of the large local manufacturers, a member of the Council, who conducted us over the premises, spoke with enthusiasm of the great service which the school has rendered to the trade of the district. It was represented that many students are drawn from comparatively remote places, possessing neither the variety of machines nor processes of manufacture, nor, indeed, the same enterprise that is to be found in the large towns. But in the school the son of a country spinner or manufacturer is enabled to master the practice and learn the theory of his trade, as well as such systems of calculation and book-keeping as will be of future importance. He also sees the newest machines by the best makers, and obtains a large amount of general information which it would be impossible for him to acquire in small country factories. Students on their return home have in many instances introduced improved systems of working into their factories, and better methods of making calculations and keeping accounts into their offices.

Spinning school.

The students of the spinning school which is, as already stated, the only one of its kind which we have seen, were doing good practical work, and doubtless their theoretical teaching would be equally good. It is very likely, taking into account the condition of the cotton industry in Alsace and in other parts of Germany and France, that a course of instruction in spinning at Mulhouse will amply repay the time and cost, particularly in the case of those who come from remote places. Whether a spinning school of this character would be of advantage in the centre of the cotton industry in England, say in Manchester, is a doubtful question, considering the facility with which efficient factories in Lancashire are open to apprentices.

Importance of theoretical knowledge.

At the same time, it would tend to the advantage of all young men destined to hold prominent positions in cotton mills if, by means of evening classes, they were taught in a systematic manner the properties of the cotton fibre and the theory of the cotton industry.

Pictorial designing.

In the weaving department of the school which seemed otherwise effective, pictorial design of the highest kind was not attempted; possibly, to some extent, from the fact that hitherto original and elaborate designing has not entered largely into the cotton and wool textiles of Alsace; the cottons being woven plain for printing, and the wool goods generally plain for piece dyeing. The principles of design are, however, taught at the admirable school of art of the Industrial Society, and the

knowledge thus acquired may be applied in the designing room of this school and carried forward step by step to the loom. Although we did not observe the connection between the school of art and the weaving school, on the one hand, and the weaving school and the dyeing school on the other, it may be taken for granted, as all the schools are patronised by the Industrial Society, that they work in harmony in carrying out the ends which the Society has in view. In Alsace the best designers find work in calico-printing, which affords greater scope for talent than textile designing, and opens up better chances of remuneration in the designing ateliers of Paris. We were informed, not only in Mulhouse, but also in Paris, that such is the repute of the art schools of this locality, and the influence of the superb museum of printed and textile designs, that Alsace sends more designers to Paris than any other district on the Continent. It is but fair to make this statement, in order to justify the apparent weakness of the department in the weaving school for designing. A syllabus of this school will be found in Appendix, Vol V.

Good designers come from Alsace.

The Royal Weaving, Dyeing, and Finishing School, Crefeld.—On the visit of the Commissioners to Crefeld in June 1882, we were conducted over the temporary weaving school by the president of the Chamber of Commerce, Herr Heimendal, the vice-president Herr Carl Königs, and a number of the leading manufacturers, who also showed to us the new building in course of erection for a weaving, dyeing, and finishing school. We were greatly impressed by the magnitude of the premises, the completeness of the scheme of instruction, and the enthusiastic interest in the movement displayed by these Crefeld manufacturers.

Weaving, Dyeing, and Finishing School, Crefeld.

The new school having been opened in December 1883, a special visit was made to Crefeld, in February 1884, in order that it might be carefully inspected and reported upon. Dr. Grothe in his account of the project states that the school "is to serve as a specimen school for Germany, and is "intended to cultivate and to promote to an equal extent all "branches of the textile industries." To effect this object "no "expense will be spared either by the Government or the local "authorities."

A government school has been in existence since 1855, but not until 1878 was the movement started which culminated in the erection of the present building. The Chamber of Commerce finding that the silk industry of the town was languishing in consequence of the superiority of the products of other countries, particularly France, in designing, dyeing, and finishing, petitioned the Prussian Government for an inquiry which resulted in two State commissioners, and two delegates from the Crefeld Chamber of Commerce, being sent to the seats of the textile industries in France in order to study the causes of their

School has existed since 1855.

superiority. The Commissioners reported that the improvement in French industries had been materially promoted by the technical schools and schools of design, established in French manufacturing towns, and recommended that the Crefeld school should be completely reorganised and established in appropriate buildings.

It was further considered that as the town of Crefeld, during the preceeding 10 years had spent no less a sum than 215,000*l.* in the erection of primary schools, it was worthy of special assistance in the foundation of the Royal weaving school, particularly as the textile industry of the whole country would benefit by the outlay.

Cost of building.

The building was erected by contributions from the following sources:—

	£
The municipality gave the land, valued at -	5,000
Municipal grant to the building fund - -	7,500
State grant to the building fund - - -	27,500
Contributions to dyeing school by manufacturers	2,500
Total cost of building - -	£42,500

Building.

The building is a handsome structure of brick with decorated stone facings of the style of the Early Renaissance. It is two storeys high, with a number of extra rooms in the roof lighted by dormer windows, and used as private ateliers by some of the students of design. In addition to a main front of 64 yards, there are two side wings, one of 60 and the other of 88 yards, while the space between is partially occupied by the weaving shed containing 940 square yards of floor space. There are also a boiler house, and other offices.

Class rooms and collections.

The ground floor contains reading room, lecture rooms, and class rooms for the weaving students. These are all substantially furnished, with desks or tables, cabinets of objects, collections of patterns, lockers and drawers for the books, drawing boards and materials belonging to the students. In each room there is a platform for the instructor and black board ruled in squares for diagrams and designs. The chemical, dyeing, and finishing departments, are also on the ground floor.

On the first floor are the rooms for drawing and designing, the museum of textile fabrics, and the private rooms for the director.

The attic floor contains, as previously mentioned, a number of studios for designers.

Machinery and motive power.

The weaving shed, as will be seen from the prospectus in the Appendix, is supplied with winding, warping, spooling, and card cutting machines, and a complete equipment of looms for varied patterns and combinations in all the textile materials, from silk ribbons and velvets to jute curtains and carpets. Altogether there are 33 hand looms and 27 power looms. In

the shed there are two engines, a 12-horse-power compound steam engine, and a 4-horse gas-engine.

Workshops.

The mechanics' shop for repairs contains a forge and anvils, a lathe for metal, shaping machine, boring machine, four vices, two grindstones, emery wheel and saw sharpener, a lathe for wood, a circular saw, three joiners' benches, besides a number of small tools.

The class rooms are lighted by electricity, one of Edison's incandescent lamps being apportioned to each student, while in the corridors outside the class rooms there are wardrobes under lock and key.

The electric light is supplied by two dynamo machines, driven by a 12-horse-power engine in the basement.

Annual income and expenditure.

The school derives a portion of its annual income from the fees of the students, and the deficiency is made up by grants from the State, the Municipality, and the Chamber of Commerce. During the present year (1884) the deficiency is expected to be 3,000*l.*, which will be raised as follows:

	£
The State (half the expenses up to a maximum of 1,500*l.*) - - - - -	1,500
The Town, one-fourth - - -	750
The Chamber of Commerce one-fourth (from the profits of the Silk Conditioning House) -	750
	£3,000

Staff.

The teaching staff consists of a general director, Herr Emil Lembcke, and a number of specialists who have had experience as practical designers, draughtsmen, managers of looms, and overseers in factories. There is also a master joiner and a master mechanic. In the dyeing department there is a special director, Dr. Lange, who is assisted by practical dyers and finishers of superior technical knowledge.

Age of students on admission courses.

Students are admitted to the school at 14 years of age, provided they can pass the entrance examination. The complete course of instruction is of two years' duration, and begins and ends at Easter in each year. Special courses of shorter duration may be arranged with the director.

Fees.

There is a graduated scale of fees, (*a*) for Prussians, (*b*) for all Germans other than Prussians, (*c*) for all foreigners.

For Prussians the fee per half year for the first year's course is 3*l.*; for the second year's course 4*l.* 10*s.*, with 2*l.* 10*s.* extra for the use of a private studio. For all other Germans the fee is 50 per cent. higher, while for foreigners, the fee per half year for the first year's course is 7*l.* 10*s.*, for the second year's course 10*l.*, and for the use of a private studio 5*l.* per half year extra.

For students of the weaving school, who wish simultaneously to take part in the classes of the dyeing school, the fee for Prussians is 5*l.* per half year, for other Germans 7*l.* 10*s.*, and for foreigners 12*l.* 10*s.* per half year.

Patterns are supplied.

The patterns for decomposition, as well as the necessary weaving materials, are furnished by the school free of charge. In the studios, however, the colours and materials are supplied by the students themselves.

Certificates.

Certificates are granted, and in special cases prizes or written testimonials are given to the students who attend the full courses.

The prospectus states that suitable lodgings with respectable families may be procured by non-resident students.

Scholarships.

A commendable feature of the school is the provision of scholarships, by which deserving poor students are admitted to the advantages of the school free of charge. The fees of from 25 to 30 such students are paid by the Province, and an endowment has been formed of the value of 2,000*l.*, whereby scholarships have been established admitting 22 artizan students to the Sunday classes of the school.

Number of students.

Although only formally opened in December 1883, at the time of our visit in February, the day courses of the school were attended by 150 students, and the Sunday classes by from 50 to 80 students. A large accession to these numbers is expected at the commencement of the school year at Easter.

Course of instruction.

In order to carry out systematically the aim of the school the course of instruction is divided into two sections, theoretical and practical. The first includes a thorough training in drawing, and the second, practical instruction on the loom. Drawing and painting are taught from copies, models, and from natural plants and flowers, with adaptations to printing, and designs for other branches of the textile industry. Due prominence is given to geometrical and machine drawing, particularly of those parts of the loom which affect the pattern in the woven fabric. As much care is bestowed on the student with a mechanical turn, as on one whose talent takes an artistic direction.

Lectures.

There are also lectures on textile fibres, on the elements of weaving, and on machinery. Fabrics are decomposed and explained; looms are arranged for weaving plain goods and for goods with simple designs in various materials by the students, while technical calculations and book-keeping are systematically taught. In the second year the art instruction of the student is continued until he is able to invent and produce original designs. Lectures are given on the principles of ornamentation of woven or printed fabrics, while due advance is made in geometrical and machine drawing.

Practical work.

When the student shows capacity for higher work, he is admitted into one of the studios, where, under the special direction of qualified designers, he is encouraged to give play to his own imagination, and to produce new and original designs in colour or otherwise, which can be woven by himself or other students on the premises, and submitted to the trade. In the technical and practical department of the second year, the student continues his studies in the decomposi-

tion of patterns, and in the composing and calculation of designed materials. He attends lectures on the construction, erection, and action of different looms, and of other machines used in weaving. He unmounts the power loom piece by piece and builds it up again. He works at the forge, and learns the use of the machine and hand tools in the mechanics' and joiners' workshop. He cuts the cards in accordance with his own designs on the paper prepared by his own hands; he fixes the cards in the jacquard machine or engine, and finally becomes thoroughly practised in the weaving of the most complicated and figured patterns both in hand and power looms.

Museum of textiles, raw materials, &c.

In going over the various departments of the building our attention was directed to the museum of textile fabrics and the superb collection of textile patterns, which already form a portion of what is intended to become the most important school museum of its kind in Europe. In addition to cases of raw material, and screens of modern silk and other textile designs, there is a collection of historical patterns containing specimens of a most varied and valuable character (the "Krauth" Collection), bought by the Government at a cost of 1,500*l.*, and presented to the school. The arrangement of the patterns is intended as much as possible to facilitate easy reference by students and designers; most of them are fixed in glazed frames, so as to protect the patterns from dust, yet easily removable when close examination is necessary. Upwards of 5,000 specimens are framed in this manner, many of which are exposed on a number of screens arranged in the museum—sheltered by curtains that can easily be drawn aside, while the others are arranged in cabinets in their due order as to style, material, and date, from the 10th century to the present time. The Crefeld manufacturers are especially proud of the museum, as a fountain at which students, designers, and manufacturers may refresh their faculties and receive at every visit new ideas and suggestions for their special industries.

Library.

The school library contains already 1,200 volumes of well selected art and textile books. The patent records are supplied by the Government, and the periodical literature includes the fashion papers from Paris and other centres. The sum of 1,500*l.* has already been set aside for the purchase of books, and the library and reading room are not intended for the use of teachers and students only, but on certain days of the week are open to the public.

Weaving shed.

Without attempting to give a detailed description of the contents and general arrangements of the weaving shed, we may say that the varied and extensive collection of hand and power looms, the display of complicated and artistic patterns at work in the looms, and the business-like air of the whole department impressed us exceedingly. Probably in no single factory in the world, as in no other existing school, can there be found so many

examples of modern looms, or so great a variety of textile fibres and designs, or more effective methods of imparting instruction in the processes of weaving.

Dyeing and finishing department.

The Dyeing and Finishing School.—The dyeing and finishing departments of the school are arranged with the same completeness and efficiency as distinguish the designing and weaving branches, and are under the management of a special director, Dr. Lange.

Prospectus.

The prospectus is important, and we give it in full. It states that the aim of the department is:—

1. To give to those who wish to devote their whole time to the study of chemistry, a complete education in this science, as well as in its practical applications.
2. To give to dyers, bleachers, calico-printers, and finishers, a sound knowledge of the manufacture of dyes and mordants, to instruct them in the methods of examining and testing the value of both natural and artificial dyes, as well as other chemicals, and further to instruct them in carrying out these operations themselves. Lastly, by means of practical work in dyeing, bleaching, printing, and finishing, to afford them opportunities for applying their knowledge to practice.

Class rooms and laboratories.

Besides the necessary class rooms, the department has:—(1) Two chemical laboratories; (2) one large dyeing laboratory; (3) a dyeing and finishing house, furnished with the most recent and complete machinery.

The two chemical laboratories serve for carrying out qualitative and quantitative analyses, as well as for other practical work.

In the dyeing laboratory the dye-wares and mordants are tested, and all the operations of dyeing and printing by hand are here carried out on a small scale.

In the dyeing and finishing-house, cotton, wool, silk, linen, jute, &c., &c., are bleached, dyed, printed, and finished on a large scale.

All the laboratories are fitted with the most recent arrangements, steam, water under high and low pressure, gas, electric light, &c.

During the course, it is expected that visits will be made to some of the most important industrial establishments in Crefeld and the neighbouring towns.

School course.

The following subjects are taught:—First year's course, first half year: (*a*) lectures on inorganic chemistry (with experiments), physics (with experiments), and qualitative analysis; (*b*) practical work in the chemical laboratory, and in the dyeing and finishing house; (*c*) machinery, drawing, and textile fibres.

Second half year: (*a*) lectures on organic chemistry, physics (with experiments), and quantitative analysis; (*b*) practical work

in the chemical laboratory and in the dyeing and finishing house; (*c*) machinery, drawing, and textile fibres.

Second year's course:—First half year: (*a*) lectures on technical chemistry, including water, fuel, soap, the most important acids and salts for dyeing and printing, thickeners used in printing and finishing, artificial and natural dye wares, and the methods employed in testing them; (*b*) practical work in the dyeing laboratory, and in the dyeing and finishing house; (*c*) machinery and drawing.

Second half year: (*a*) lectures on dyeing, bleaching, calico printing, and finishing, chemical technology of woven tissues; (*b*) practical work in the dyeing laboratory, and in the dyeing and finishing house; (*c*) machinery and drawing.

Conditions of admission.

Students wishing to attend the school must have passed their sixteenth year of age, and must have an elementary knowledge of chemistry and physics. As a rule no student is admitted without having passed an entrance examination, from which, however, he is exempted if he can show by certificate that he has obtained the necessary knowledge at a public school. Those who wish to give their whole time to the manufacture of dyes, and the processes of dyeing and finishing, may make special arrangements with the director, and in such cases exceptions are made as to the entrance examination and the time of study. The complete course lasts two years, and begins every year at Easter. The admission of a student at any time other than the beginning of a year's course depends upon the decision of the director of the school of dyeing.

Fees.

The fee per half year is—for Prussians, 5*l.*; for all other Germans, 7*l.*; for foreigners, 12*l.*

Important deductions may be made, by means of the scholarship funds, in the case of students of limited means.

Laboratory fees.

For the laboratory the student has the use free of charge, of a working desk, fuel, chemicals, and re-agents, with the exception of silver nitrate, platinum chloride, and gold chloride. Further by the payment of 1*l.* 10*s.* caution money, as he has the use of all the apparatus, porcelain, and glass vessels, &c. which he may need, but for which he is made responsible. Missing, damaged, or broken apparatus are charged at cost price. Each student is obliged to bring his own platinum and blow-pipe. The preparations made from the chemicals of the laboratory, are the property of the department. The laboratory is open daily, with the exception of Saturday afternoon from 8 to 12 and from 2 to 6 o'clock.

Certificates.

Students who have frequented the department for one year at least, obtain a leaving certificate. After each half year, certificates are also issued respecting the diligence, progress, conduct, and attendence of each student. In special cases, students on leaving may receive marks of distinction in the shape of prizes or written testimonials.

Collections.

Besides the utensils and apparatus necessary for teaching, the department possesses a well-equipped physical cabinet, extensive collections of chemical preparations and colouring matters, and a library. In the latter most of the journals relating to dyeing are taken for the use of the students.

Opinions of Crefeld citizens respecting the schools.

In conversing with some of the leading citizens of Crefeld, the old school was very favourably spoken of, and strong hopes were expressed as to the usefulness of the new one. Instances were given of students at present engaged in the various factories, who have been able to turn their knowledge obtained at the school to very valuable account. Employers whose sons had gone through the course of instruction in the old school were highly satisfied with the thoroughness and efficiency of the training which they had received, and manufacturers are constantly on the look-out for students who have attended the classes.

We often heard that to practical Englishmen, it must be self-evident that a people like the Germans, already taxed to the utmost to meet their enormous civil and military expenditure, would not voluntarily increase their public burdens unless they had overwhelming evidence that compensating good would follow. In the race for the development of machinery the human machine was after all the most important, and in the long run paid best for the efficient labour expended upon it. The silk industry of Crefeld had grown beyond the most favourable anticipations of the manufacturers themselves. The increase in power-loom weaving had been very remarkable, but not more so than the extension of fancy weaving. Crefeld during recent years, as an exporter of silk goods, had obtained a firm foothold in London, in America, and in the centre of fashion, Paris itself. In every manufacturer's establishment there had been an awakening; there was more enterprise, a greater desire to strike out new paths, a keener interest in competing for the best and most valuable productions. Our informants insisted that the chief motive power in all this development had been the weaving school, and that its influence had been chiefly felt in two important branches in which the factory is most liable to fall behind, viz., designing and dyeing. It was shrewdly remarked by one of the manufacturers "the day has gone by when I can "make money without effort; to exist I must move on; my "neighbour compels me."

On asking why, in a town like Crefeld devoted almost solely to the manufacture of silk goods, the weaving school should devote so much attention to other materials, such as wool, cotton, jute, &c., we were told that the promoters are in the first place most anxious to introduce other branches of the textile industry into Crefeld, in order that they may have "more strings to their bow," and that in times of depression in the silk industry they may obtain relief from other branches less depressed. In the second place, many of the students live in districts where silk

weaving is unknown, and where other fibres only are worked. Besides, students training to become designers, seek familiarity with every material and with every process by which the surface of a woven fabric may be appropriately decorated. Students expecting to become distributors of goods, seek to know the make and construction of as many classes of goods as possible. One of the English students with whom we spoke, was the son of a loom-maker in Lancashire, and to him the complicated motions of the various Jacquard looms and the methods of weaving the several kinds of fabrics were an interesting study. One of the students in the dyeing department was connected with the straw plaiting industry, and was devoting himself under Dr. Lange to the study of straw dyeing. Thus for many purposes and from many countries, students seek instruction at this school, and the people of Crefeld cheerfully pay the high rates necessary for its efficient management, while they point with pride to the fact that by their sacrifices they are finding out and directing the talent of rich and poor in the neighbourhood and benefiting the country at large.

Weaving Schools of Saxony.

Chemnitz Weaving School.

The *Higher Weaving School of Chemnitz* was founded in 1856, and according to Mr. Felkin's account, which was confirmed by all the authorities with whom we conversed, "has been of great benefit to the trade of the town and district." The example set in Chemnitz has been extensively followed; "similar schools "exist in the neighbouring towns of Glauchau and Meerane, "besides schools for a similar object, with a less extended course "of instruction in Lössnitz, Oederau, Mittweida, Hainichen, "and Frankenberg, places adjacent to Chemnitz, where the "weaving industry is mainly carried on. The Chemnitz school "is the largest and most important, and is in many respects "considered a model institution."

Other schools.

School building.

The school building is situated in an open space in the centre of the town, and was built about thirteen years ago. It is a substantial structure three storeys high. The class rooms are lofty and well lighted. In the basement is a large room containing sixteen power looms, each of different construction, driven by a small steam engine. On the first and second storeys are large rooms containing winding and warping machines, and forty-three hand looms, of variety sufficient for the production of all kinds of textile fabrics, from the finest silk handkerchiefs to the coarsest carpets.

Cost and maintenance.

	£
The land on which the school is erected was granted by the town, and valued at	500
The building was paid for by the town, and cost - - - - - -	4,000
The looms and other furniture are valued at	1,500
Total cost of school and fittings -	6,000

The State pays the town six per cent. on the cost of this building; five per cent. as interest, and one per cent. for repairs. "The town and State each grant 150*l.* annually to the school. "This, and the fees of the pupils, barely meet the expenses of "the institution, and the deficiency has to be made up either "by the town or State from year to year."

Management. The school is under a committee of four, consisting of two aldermen or Stadträthe of the town, the director of the higher technical school, and a manufacturer in the trade. There are four teachers, of whom two are for practical weaving. At the time of our visit there were 52 students of 14 years of age and upwards. They pay 13*l.* 10*s.* a year for tuition, with seven weeks Fees. holiday; or for half-a-year 9*l.*, with 1*l.* 10*s.* a year additional for weaving materials. The hours of study are from 8 to 12 and from 2 to 6. There is no evening instruction. Certificates of the diligence, attendance, and progress of the students are granted, and "the directors reserve to themselves the power, in special "cases, to distinguish scholars by premiums or written testi- "monials." For the school curriculum, representing the two divisions of instruction, each extending over half-a-year, *see* Appendix, Vol. V.

Methods, materials. In passing from room to room and noting the work of the students, it was evident that the teaching of practical weaving Hand loom Department. was thorough and efficient. In the hand loom department the warps were nearly all in short lengths for patterns merely; in carpets there were tapestries, rugs (light and heavy), with woollen weft; tweed cloth, in woollen; damask table cloths and curtains in worsted warp and weft, and also in jute; rough linen towels, and woven purses. No two looms contained the same material or design, and each student learns to design and prepare the cards for every class of pattern in the different materials. All the warps are put into the looms by the students, and all the Method of teaching. "tuning" of the looms is done by them, under the supervision of practical teachers. Each student works at every pattern in each loom till he understands the "weave" and can work it without assistance. Then he passes on to the next loom, and his place is filled by another student. Thus, without unnecessary waste of material, the students are taught by actual experience to put many kinds of patterns of different materials into the looms.

Jacquard looms. From ordinary pattern and hand looms the students pass forward to the Jacquard looms, of which there are twenty of the most important and varied kinds obtainable. Some looms were weaving figured Brussels carpets; one was weaving a velvet pile. The silk looms differed in construction accordingly as they were intended for ribbons, for brocades with raised patterns such as are woven in Lyons, or for Swiss brocades such as are made in St. Gallen. Some students were weaving monograms and pictures for book-markers, like those of

Coventry. Others were showing their ingenuity and mastery of the Jacquards by weaving their names in black silk on a white ground, so as to appear like visiting cards. There were fancy patterns in woollen cloths, and mixtures of cotton, wool, and shoddy, that would almost puzzle an expert to decompose, while in mixtures of cotton, silk, and worsted, the varieties were endless. We were told that patterns are often sold by the students, and occasionally "commercial successes" are produced in the school.

Power looms.

Having become thoroughly conversant with the use of the hand looms and of the Jacquard looms, the students are taught to apply to the power loom the complicated designs and patterns that have been produced in the hand loom. It has long been the boast of some makers that they can construct looms adapted to weave by power anything that can be woven by hand, and the patterns in some of these looms would almost justify the statement. The students follow the same courses in power loom as in hand loom weaving. They design patterns for the various kinds of looms, and spend at least as much time over the weaving of each variety as enables them to comprehend the complete structure of the pattern and the manipulation of the loom. It was said that the weaving of full length pieces, or even of long webs, is seldom attempted; in this respect the plan adopted is different from that of the Mulhouse School.

Looms chiefly of English make.

Most of the looms were by English machinists; the names of Bradford and Keighley makers being conspicuous among the worsted looms. There were also some excellent looms by Chemnitz machinists, held in high esteem by the director; two makers especially being well represented. One of the names was new to us, but we were informed that the firm represented had turned out its 20,000th loom about three months before our visit.

Absence of art teaching.

Before considering the influence of this school upon the industries of the district, we wish to draw attention to one weak point, which was admitted by some of its promoters, and, as we have already remarked, is so common in these weaving schools. The provision for teaching pure art, and art applied to textile designs, we found to be very small. The other departments of so-called designing, seemed to be admirably conducted. Students are taught to copy patterns, to adapt designs from one material to another, to vary the colour and form, to invent new combinations, twills, &c., and to work out all these designs on the cards, and mount them on the jacquard loom. The importance of this work can hardly be over-estimated, and for one who is already an artist nothing could be better. But, to the student ignorant of drawing, those aids to pure design and artistic culture which we found so amply provided in the art department of the Vienna weaving school were conspicuous by their absence.

Influence of the Chemnitz school.

There was a general concurrence of testimony in favour of the school on the part of all manufacturers with whom we spoke. The classes are attended by merchants and distributors of goods as largely as by the sons of manufacturers. We have elsewhere stated that we were informed that there is not a manufacturer in the town whose son, or assistant, or overseer, has not been through the course. The fame of the school has spread to England, and among several English students who have attended the classes during the last few years are the sons of some of the largest manufacturers and merchants in Yorkshire, who, before schools of this character were started in England, selected the one at Chemnitz as supplying the best preparatory training for the factory. Some of the manufacturers send their overlookers for a six months' course. Others attend the school after a training in art at such schools as the Kunst-Gewerbe School at Dresden, and engraft designing for the loom upon a knowledge of art. Others again come from the technical art schools to the designing room of the factory, furnish the pictures—the original designs—in colour and form, and pass them forward to the so-called "designers" in the same establishment, who have been trained in the weaving school.

Importance of knowledge of technical designing.

An artistic and technical knowledge of designing and of weaving are considered at Chemnitz to be almost as important for the merchant and distributor of goods as for the manufacturer. The former can suggest intelligently to the manufacturer the nature of the popular wants, and how they may be supplied; he may even furnish the manufacturer with designs, instead of being compelled to accept such as he knows to be defective, but which he does not know how to improve. He is also better able than the untaught buyer to detect faults and imperfections in the finished piece, to understand how they occur, and to suggest remedies. Some manufacturers are jealous of the possession of this knowledge by merchants and buyers, and in many cases have opposed the establishment of weaving schools in consequence; but it cannot be denied that, the more a trade is understood by all the parties connected with it, the higher will be the general excellence attained.

School for hand weavers.

There is in Chemnitz a school for hand-loom weavers, open on Sundays and during the evenings of week days, which must not be confounded with the above. It is intended for teaching designing, pattern drawing, analysis, book-keeping, and fancy weaving, to practical weavers anxious for improvement. The fees are sixpence per month, and admission is free to exceptionally poor students. The school is mainly supported by grants from the State and municipality, and by assistance from the weavers' guild. Some foremen, piece "perchers," under clerks, and warehousemen, have improved their technical knowledge in this school, and some of the managers spoke in praise

of its usefulness to skilled weavers and foremen who were unable to take advantage of the higher school. Two of the Commissioners, however, visited this school and were not favourably impressed by it.

Weaving Schools in Austria.

Weaving schools in Austria.

There are in Austria 22 weaving schools and two hosiery schools, under the control of the Minister of Instruction, dealing with various textile materials, such as silk, wool, cotton, flax, &c. Besides the one at Vienna, which we have selected for description, they are distributed over Bohemia, Silesia, and Moravia. A paragraph in the introduction to the programme of the Vienna school states that "none of these schools could exist without State aid." The State grants are however exceedingly small. Of the hosiery schools the most important receives 208*l.* (2,500 gulden) a year; 13 schools have a State subvention of 83*l.* (1,000 gulden) and under. The estimate of the total State aid amounts to 2,500*l.* (30,000 gulden); the communities, however, contribute considerable sums for premises, fuel, gas, and other expenses. In the above programme, the State assistance to the schools is considered "entirely insufficient," and a reference is made to the Crefeld School, where the authorities, after buying machinery, recently expended 1,500*l.* on a collection of old designs alone. Now, it states, they are building at Crefeld a new school, for which "the town gives the land and 7,500*l.*, and the State "27,500*l.* This one school, which will be devoted pre-eminently "to the silk industry, will consequently cost more than all the "schools in Austria combined." The Report further states, that although Austria has maintained her textile industries until now on a level "which far surpasses the means of instruction within "the reach of their promoters, it would not be advisable to allow "such an anomaly to exist much longer. The enormous efforts for "improvement that are made by France, Germany, England, "Italy, and Russia, and the colossal sums which those countries "expend in the establishment and maintenance of technical "schools, lead us to foresee with certainty that these efforts will "not fail to produce in a short time a fatal effect upon our home "market, already the subject of much competition, and upon the "selling abilities of our own manufacturers. A further deca-"dence, a further adherence to the past, on the part of our textile "industries, would be nothing less than a calamity for "Austria."

We proceed to describe the weaving school of Vienna, whose several departments combine all the features of importance that are to be found in the other schools of this character in Austria.

Weaving School, Vienna.

School for Textiles and Dyeing, Vienna.—With regard to the suitability of Vienna for a school of this character, the prospectus states that Vienna is the centre from which the designs and orders in textile products emanate to the varic

factories in the provinces of Austria. "It is the seat of an "industry which comprises all the branches of art weaving, and "therefore the student who is trained here has an opportunity "of intimate contact with the practical processes, as well as with "all desirable institutions of culture and education, such "as the technological museum; as also for further artistic "development at the museum for art and industry. He "can therefore obtain a more varied education than he could "possibly receive elsewhere, even in the manufacturing "centres of other countries." The prospectus, after quoting statistics and adducing evidence relating to the textile industries of Austria and other countries, concludes by stating that "this "school is of the most vital importance not only for Vienna, "but also for the whole empire."

Weaving school building.

The school is a large and handsome building, and was opened within a year of our visit. It supersedes what was described to us as "the oldest weaving school in Europe," and it was the success of the old school which led to the building of the new one. The freehold belongs to the municipality, the school having been built out of the local rates; the furniture and apparatus have been supplied by the State. The building is not yet completed, as the scheme of the school embraces the erection of a department of spinning, and a vacant plot of ground adjoining the school was pointed out as the site of this proposed extension. We were informed that a full equipment of machinery for cotton and wool spinning has already been promised by English firms.

	£
The building already erected cost to the city or commune - - -	6,917
The furniture and apparatus supplied by the State cost - - - -	1,750
	8,667

Maintenance.

The school is maintained by the fees of the students, by a grant from the State, and by contributions from the local rates. We did not obtain a detailed budget of the expenditure and income, the school having been too recently established in its present form to supply reliable statistics. The State grant for the past year amounted to 1,166*l.*, and the town supplied 60 tons of coal and wood for heating purposes, and gas to the value of 48*l.*

Government of school.

The school is governed by a council of eight members, consisting of the mayor for the time being, the director, together with representatives of the State, of the Gewerbe school, the Royal Museum, the Silk Industry Society, and of the trade in textiles.

Teaching staff.

The teaching staff consists of a director, Professor Ferdinand Lieb, and professors and instructors in each of the theoretical and practical departments.

Students and fees.

At the time of our visit there were 48 day students, and 250 evening and Sunday students, making a total of about 300. The

day students pay 1*l.* 8*s.* 4*d.* a year of ten months, evening students are free. The hours of study vary, and will be given under the different departments. Students may be admitted after passing their fourteenth birthday. The school course occupies two years, at the end of which certificates are given according to merit.

Scholarships.

There are eight scholarships offered, entitling the holders to free admission, with an extra allowance for maintenance, viz., two by the town, and two by the Silk Industry Society, of the value of 8*l.* 6*s.* 8*d.* each, and three by the State, of the value of 42*l.* each. The latter are granted more especially with the object of encouraging artists to become designers.

Social status of students.

The day students are mostly the sons of provincial manufacturers and of merchants. The evening and Sunday students are usually factory managers, pattern drawers, or workmen in manufacturing establishments. A few are old day students, who take advantage of the school, as opportunities offer, for extending their knowledge.

Departments of school.

The school contains four departments, viz.:

1. Drawing and artistic designing.
2. Hand and power loom pattern weaving.
3. Dyeing of fabrics, and printing of calicoes, &c.
4. Museum of fibres, designs, mechanical models, &c.

The textile instruction is divided into two distinct departments, namely, a school for drawing applied to manufactures, and a weaving school. Students may attend either or both departments, and the hours of study are arranged accordingly. Drawing is taught on Tuesday, Thursday, and Saturday mornings from 8 a.m. to 12 a.m; weaving is taught on Monday, Wednesday, and Friday, from 8 a.m. to 12 a.m. In the afternoon the students work out their problems at home. In some instances they attend the commercial school, or are employed in some textile factory. In both departments instruction for assistants and apprentices is given on Sundays from 8 to 12 a.m., and on Mondays from 6 to 9 p.m.

Department for designing.

The drawing and designing department of the school impressed us very favourably. It seemed here to be recognised, more than in any other school (Crefeld excepted), that it is necessary, first, to teach original designing, and afterwards the application of designing to the loom. For this purpose, drawing is taught thoroughly, and, in the first instance, as pure art, but always bearing in mind its ultimate application to industrial design. This department is a well equipped school of art in itself. A large collection of the best casts from the sculpture in the Royal Museum, in Vienna, furnishes models for the students. The room devoted to model drawing is divided by a number of screens, so arranged that each student has a compartment to himself, with a separate gas

pendant that can be raised or lowered so as to give appropriate lights and shadows. For designing and painting there is a large room with tables, racks, and stands for the arrangement of copies and patterns, so that they can be examined and dissected easily, with ample light for each student. The walls of this room are covered with drawings and designs of various kinds, some of them executed by students, all framed and numbered, and, where necessary, as in the case of historical textile patterns, fully described. Other drawings and designs of great variety and value are stored in cabinets, and from time to time these are displayed and copied. Attached to many of the designs is a skeleton diagram or key, showing the colours employed, and indicating each thread of warp and weft as it appears on the jacquard. We were informed that upwards of one hundred of the most recent books relating to textiles from different countries have been cut up, so that the pictures and designs could be the more conveniently used as copies. For facilitating the work in this department, there is a library of 106 volumes, more than 90 of which relate to design, and every important new work that is published is added to the collection. (For particulars of the course of instruction in drawing and painting, see programme, Appendix, Vol. V.)

Use of natural flowers for design in the Vienna Weaving School.

The most important feature of the instruction in the designing department is the adaptation of natural flowers for textile designs. This course begins on the 15th of May; flowers are supplied from the public gardens of the city, and are used as copies, to be treated separately or in groups for textiles and for calico-prints, in the methods and according to the colours and materials indicated by qualified professors. The student is taught to arrange natural forms and colours in accordance with good taste, and economical application to the intended material, and he learns to apply them first to paper, and afterwards to the point paper ready for the loom, with all the technical and commercial calculations attached.

Students prepare their design for the loom.

We saw a number of advanced students engaged in enlarging their own original drawings on prepared designing paper, ready for the card cutting process. Having prepared their designs, they cut the cards with their own hands, and mount them on the jacquard. They prepare the warp, carrying the threads through the healds and reeds, and finally, placing the weft in the shuttle, are able with full knowledge of their work to weave the pattern in the loom.

Patterns are dissected by students.

In another class room we saw a number of students, all of whom were said to be practically familiar with the loom, engaged in dissecting patterns of cloth, as a class exercise. A small pattern had been given to each by the instructor, and the pupils were required to copy the design, count the picks, dissect the cloth, thread by thread, so as to ascertain the nature and quality of the material employed in its construction. They were to estimate the counts of the warp and weft, calculating

the quantity of each required for the weaving of a yard of cloth, and the cost per yard of the finished piece.

Students are exercised with a great variety of materials.

All kinds of complicated patterns are given to the students, some containing mixtures of silk, mohair, wool and cotton, and elaborately figured. In some cases the counts of warp, weft, &c., of the various fibres are given, with prices of each, per pound or per gross, and the students are required to calculate the length and weight of each material and the cost per yard of a finished piece of given width and length. All these calculations are taught by practical men whose experience is founded on the commercial usages of the foremost manufacturing establishments, not of Austria only, but also of France and England.

Practical weaving.

The practical weaving, both by hand and power looms, is taught in a large airy room, of about 90 feet in length by 45 feet wide, lighted by eight large windows on each side. (For the courses of the two divisions of treadle weaving and jacquard weaving, *see* Appendix, Vol. V.)

Looms and knitting frames.

In the weaving room, besides winding, warping, and dressing machines, we counted 13 hand looms and about the same number of power looms. For work of a specially detailed character, or belonging to other departments of the textile industry, there were separate rooms. In one of these rooms there were four hand looms for braids, the work being that used for State carriages, officers' trimmings, &c. The work was very rich and elaborate; gold and silver thread yarns being profusely mixed with silk; and, both in design and execution, showed evidence of marked skill on the part of the students. Another room was devoted to machine knitting; there were a number of beautiful hand machines, containing jerseys, Shetland and other fancy shawls, stockings, &c., in process. There were also lace machines; and cabinets, with an extensive collection of models of machines, one-fourth the original size. A room was devoted to the exhibition and use of card-cutting machines more perfect than those usually found in manufacturing establishments.

Hand looms.

In the hand looms in the general weaving room there seemed to be almost every kind of material represented. In construction and arrangement the looms were similar to those of the Chemnitz school, containing more or less complicated patterns, from plain and figured silks to jute, damasks, and heavy carpets.

Power looms.

Of power looms the school contains the best of their kind that can be procured. We noted a modern Crefeld velvet loom, a complicated jacquard loom from Chemnitz, and ribbon and other silk looms for weaving on the French, German, and Swiss systems. A Bradford and a Keighley maker were each represented by a quick-speeded "pattern loom," and we were informed that other looms were ordered or were promised by leading English and Alsatian makers.

Variety of looms.

As in the case of the hand looms, no two power looms were alike, and a glance at their contents showed rich silks, pure and

mixed worsted and cotton fabrics for dress goods, worsted and jute damasks, worsted coatings, heavy woollen cloths, and Brussels carpets.

Unlike many of the other schools visited by the Commissioners, the students are here required to pay for the materials which they use for weaving. Varieties of material, of all kinds, are stored on the premises, but nothing is given out without payment. The students have the disposal of their woven products, and frequently sell the designs and patterns which they make. The weaving of long webs is not encouraged.

Dyeing department of Weaving School, Vienna.

The *dyeing department* is separate from those of designing and weaving, and students may either enter it without attending other classes, or they may go through all the departments. The dyeing school was, originally, a private undertaking under a committee of manufacturers and others. Considerable difficulty was experienced in retaining the professors, as employers were constantly outbidding the committee and taking away the best men. Since the transference of the school to the State, better salaries have been paid; a higher social standing has been acquired by the teachers; and they do not now so readily leave to take private situations.

Chemical laboratory.

There is a large chemical laboratory, with places for 20 students. Water, steam, and gas, are laid on for each, and other necessary appliances are conveniently arranged; the chief professor has a private laboratory. There are class-rooms, and a lecture theatre. In the director's room there is a library of works on dyeing and calico-printing, a considerable number of which were in English.

Cost of fittings.

We were informed that the laboratory fittings and other arrangements cost 1,166*l.* (14,000 gulden), towards which 500*l.* (6,000 gulden) was contributed by the State.

Department for practical dyeing.

The department for practical dyeing was not completed at the time of our visit. The furnaces and boilers had been arranged in accordance with a convenient plan for working, and some large copper pans and machinery were in their places. Among the mechanical arrangements was a stand in which 20 small porcelain pans, provided with wooden handles, were fitted, and by the turning of a winch 20 patterns or hanks could be lowered into them simultaneously, and all lifted out at one operation.

The professor of this department (M. Lichte) was trained at the Polytechnic School of Zurich, and afterwards worked, for 13 years, in chemical and dyeing establishments in Alsace.

Chemistry taught to all students.

All the students learn theoretical chemistry, but only those intended for the trade of dyeing study practical chemistry, and they may select their own course of one or two years. A course of one year is considered sufficient for obtaining the necessary knowledge of one fibre.

Students come from Polytechnic.

Most of the students have studied chemistry before entering the school, and are therefore able, with very little preliminary

training, to apply themselves to the study of dyeing. We found five students in the laboratory who had gone through Polytechnic Schools. It is not surprising, therefore, that much of the teaching is of an advanced character, and that the students are able, after a course of two years, often of one year only, to go direct to work as qualified dyers, without apprenticeship.

Calico-printing.

Connected with the dyeing department, practical instruction is given in calico-printing. One room was fitted up for block printing; another was prepared for illustrating machine printing by means of working models of all the processes. These models had not arrived at the time of our visit, but it happened that while we were in Mulhouse we were conducted to the establishment of M. Emil Welter, a maker of small machines and mechanical models, and he showed to us the set of models of printing machines which he had just completed for the Vienna school. As an indication of the amount expended on such machines we may state that the Council of the Vienna Weaving School had contracted to pay 800*l.* for these models. It may be worth mentioning incidentally that, when we visited Mr. Welter, in order to see the machinery preparing for Vienna, we found there the whole of the advanced class from the Mulhouse Weaving School, who, with a professor, were examining these models then just completed.

Museum of fibres, raw materials, machinery, &c.

In addition to the appliances necessary for the complete study and practice of designing, hand and power loom weaving, dyeing and calico-printing, the school contains a museum for the collection of examples, artistic productions, raw materials, mechanical models, and various other objects pertaining to the textile industries, displayed with great taste and convenience. As no such museum exists in England, the nature of the collections may be better understood by referring to some of the exhibits in detail. The cotton industry, for example, is illustrated by a number of cases divided into sections containing raw cotton from various countries. The processes of manufacture are shown by samples of the result of each successive operation, the machinery being represented by photographs. Thus the cotton slubbing is shown, and with it a photograph of the drawing frame, and so on from stage to stage up to the spinning, which is not only illustrated by photographs of the mule jenny, but by actual spindles, flyers, and spools, finishing with the cops in the shuttle ready for weaving The cotton fibre, (which from time to time is described and exhibited by microscope and electric light in the lecture room), is here illustrated by magnified drawings showing the characteristics of the several qualities. In a similar manner other fibres, such as silk, wool, linen, and jute, are represented by actual specimens, as they appear in the stages through which they pass in the processes of manufacture. The shade cards, showing ranges of coloured yarns, with shades of each colour, were remarkable for variety and delicacy in the shading. Many

yarns and woven fabrics are also shown. The collection is rich in cabinets and cases of patterns of finished goods in all the materials, and from all countries. When it is remembered that most of the students who attend this school are not likely to be familiar with more than one branch of the textile industry, and that many attend the school without any prior factory experience whatever, the usefulness of these well arranged cases may be appreciated. In English museums they would not fail to be useful to all careful observers; how much more so to students who, like those of Austria, have no opportunity of seeing the processes of manufacturing under their most favourable conditions!

We were informed that these original specimens of raw materials and finished products have been contributed by manufacturers, by English and Continental machine makers, and by promoters of the school in Austria. Manufacturers send patterns of their goods, and the Paris collection of patterns is also purchased for the school, thereby giving the students frequent opportunities of seeing the most fashionable designs of the day.*

Influence of Vienna Weaving School.

Manufacturers and others with whom we conversed spoke with the greatest confidence of the future influence of the school. In considering its practical utility, the conditions of the textile industries in Austria as compared with England must be borne in mind. As before stated, in England they are localised and subdivided. In Austria, and in other Continental countries, it is not uncommon to find all the processes, from the sorting of the raw material to the spinning, weaving, dyeing, and sale of the finished piece, carried on in one isolated establishment, differing materially as to its machinery, processes of manufacture, and in the training of its workpeople, from other factories in the same district. Hence the difficulty may be understood of keeping several departments of an industry up to the mark, when they have to compete with localities in which every department is organised as a separate and distinct trade. There is, undoubtedly, an absolute necessity for technical schools in districts where in a single factory a master or manager is required to combine the knowledge of half a dozen experts, but such schools are also useful, though not to the same degree, in localities, such as we find in England, where an industry is so subdivided that an apprentice may be taught all that is done in one selected factory, and yet become acquainted with only a small branch of his trade.

* This Paris collection is formed in a curious way. There are firms in Paris whose business it is to procure samples of all the new designs in silk and other materials as soon as they are offered to the trade. They cut these into small pieces, and send them to subscribers all over the manufacturing world, at the beginning of each season's trade. Large subscriptions are paid for these patterns, and, as an instance of the uses to which they are devoted, it may be said that outside Lyons, where most of the best things are woven, they form the basis of inspiration for the bulk of the fancy dress goods that are produced in Europe and America.

Designing department.

The department of design is looked upon as the sheet anchor of the Vienna school. The promoters insist that the selling value of a piece of woven fabric, as of a printed cotton, is represented mainly by the attractiveness of the design which appears upon its surface, and that, whatever may be the deficiencies of warp, weft, or workmanship, a taking pattern, even though it may not blind the customer to other inequalities, tempts him to overlook them. So fully is this recognised by the State that it encourages this department by annually offering three scholarships for industrial designing, of the value of 42*l.* (500 gulden) each, to be competed for by students from the Royal Industrial Art School.

Instruction in theory of weaving was sound.

With regard to the theory of weaving, the calculations, the analyses of patterns of woven stuffs, the practical weaving of patterns by hand and power looms and jacquards, the instruction seemed to be thorough and effective. It was stated that in general calculations boys fresh from school made more rapid progress than students who have passed an interval of a few years in some warehouse or factory. It was also stated that the processes of arranging the complicated motions of a jacquard, the gearing of looms, and of the innumerable threads composing the warp and weft which must be worked with all the exactness and harmony of a musical instrument, can be taught more easily to boys in their teens than to men whose fingers have become stiffened by other work.

Advantage of variety.

This school also offers an advantage to manufacturing students in its extensive variety of machinery and branches of work. As we have before stated, many students have to come long distances from districts where one class of trade only is carried on, in one material, and by one class of machinery. Such students see the newest and most approved machinery for their own particular industry, and have their eyes opened to the possibilities of new branches. Although few, if any, students would be expected in after-life to establish factories in which such an extensive variety of goods should be made as is provided for in the Vienna School, it is not likely that they would know less, but rather more, say, of a cotton loom, by being made familiar with silk and woollen looms; and in the same way their knowledge of one material surely would not be lessened because of the fact that in their studies at school they had been brought in contact with many.

A practical acquaintance with the technicalities of a wide range of textile fabrics must also, as we have stated elsewhere, be of the greatest use to the important class of distributors. It is reasonable to suppose that a knowledge of the requirements of the consumers, and of the best methods of satisfying them, by those who, as it were, feel their pulse by daily contact, must tend to promote the extension of the trade.

Influence of dyeing school.

The influence of the department for dyeing and calico-printing, like that of the other departments, cannot as yet be measured by

results, owing to its recent formation. We were favourably impressed by all the arrangements, and particularly by the fitness of most of the students for technical instruction, before entering this department. As a knowledge of art forms the basis of instruction for the designer, so a knowledge of chemistry is the true groundwork for the student in dyeing. At many schools the teaching of dyeing must be superficial, because most of the students know nothing of chemistry. In too many instances the instruction has largely consisted in getting up receipts for dyeing certain colours, the necessary weighing, measuring, and mixing of the ingredients, and dyeing patterns. In this school the teaching is based on the principles of chemistry, which the students are required to understand; and in such preparatory knowledge it would appear that at present German and Swiss students are in advance of those of England. This superiority, however, may be expected to disappear in the centres of industry in England, where Science Colleges are now in active operation, and where the chemistry classes under the Science and Art Department are so rapidly extending among the artisan population.

Weaving Schools, Italy.

Weaving schools in Italy.

The Commissioners visited the Exhibition of Italian Industries and Works of Art at Milan in October 1881, and were favourably impressed with the section devoted to exhibits from the numerous technical schools of Italy. In some of the schools there are weaving and dyeing departments, and we had an opportunity of seeing the examples of their work, and of comparing one school with another. The two schools which seemed to be most efficient, judging from the display of designs, woven patterns, and samples of dyeing, were those of Como and Biella. We visited both of these schools, and also the school and museum of the Industrial Society of Milan, in which there is a department devoted to textiles.

Weaving school of Industrial Society, Milan.

School and Museum of the Industrial Society, Milan.—We were accompanied in our visit by Mr. Kelly, the British Vice-Consul, and were taken over the establishment by Signor Carlo Figini, the successor of Professor L. Bossi, who formerly had the charge of the silk school and who has written a work on weaving. There are 45 students in the school (one a female), and the teaching is gratuitous. The classes are held in the evenings, and on Sunday mornings from 9 to 11. Instruction is given in practice as well as in theory, and there is an excellent model on an enlarged scale to show the working of the Jacquard. The collection of patterns is extensive and well arranged.

Technical Institute, Como.

Technical Institute (Istituto Tecnico), Como.—The students are admitted with the diploma of the so-called technical school,

after completing their third year's course and attaining the age of fourteen years. The admission fee is 2*l.* 8*s.*, which is wholly dispensed with in the cases of poor students,—about half the students pay nothing. There are free Sunday classes, attended by 60 artisans. The course is for four years: Section I. Physics and Mathematics, II. Commerce, III. Industry, relating to the silk manufacture. No technical instruction is given until the beginning of the third year. Half the expenditure of the school beyond the fees is defrayed by the Government, and the other half by the commune. A grant is made by the Chamber of Commerce of 20*l.* a year for each pupil admitted to the technical department. The dyeing students pay 16*s.* (20 francs) a year for materials, and 20 francs for laboratory expenses. An old convent is used for the school. The class-rooms open from the cloisters, and the quadrangle serves as a place of recreation for the students. We were informed that the designing and dyeing departments of the school have exercised a very beneficial influence on the silk industry of the district. There are 76 small silk mills and over 6,000 looms in the neighbourhood. The population is not less than 26,000. The production of black silks is the leading textile industry, and till within a few years plain goods only were made. Since the establishment of the weaving school there has been a marked extension in the weaving of fancy and figured silks. Already there are 200 looms engaged in this new industry, and we were informed that the best of the weavers and the overseers in many of the weaving shops have received instruction in designing and weaving at the school. The most convincing evidence of their belief in the success of the textiles department of this institution was to be found in the sacrifices about to be made by the authorities in providing suitable additional accommodation. Roomy monasteries and convents are easily obtainable for scholastic purposes, in all the towns we visited in the north of Italy. Such accommodation, however, is not accepted as suitable by progressive Italians, and in Como some important new extensions were being made (in 1881) and have since been completed. They consist of a series of rooms for the teaching of art and its applications to design. The rooms are arranged on the best principles, well lighted, and furnished with all the necessary casts and examples. A weaving room and workshop, with accommodation for 40 looms, has been added, and a large chemical laboratory for practical chemistry and dyeing. The Como Technical Institute, thus equipped with all the outward requirements of success, with efficient professors, and ample encouragement from the authorities, may be expected to impart new spirit to the local industries which, in the face of the enterprise and fierce competition of other countries, were in serious danger of being left behind in the race.

Situated in a convent.

Influence of the school on manufactures.

Additiona buildings.

Professional School, Biella.—This important school combines for the small, but prosperous, town of Biella, technical classes

Professional School, Biel'

Professional Schools, Biella —*continued.*

with reading-rooms and an extensive library for the free use of the people.

In the industrial department of the day school there are the following sections:—

1. Weaving.
2. Chemistry and dyeing.
3. Mechanical drawing.
4. Fine art.

There are also evening lectures and classes for workpeople.

The school occupies the premises of an old convent (rent-free), the class rooms opening from the cloisters.

The school is maintained, in addition to fees, by grants from the following sources:—

	£	
Government - - -	480	a year
Town - - - -	360	„
Chamber of Commerce of Turin	140	„
Province - - -	220	„
Students' fees - - -	100	„
	£1,300	

Number of students.

At the time of our visit there were 129 day students, who pay 20 francs a year, and 270 evening students.

Laboratory.

In the chemical laboratory there were 26 students who pay 20 francs extra for apparatus and chemicals. In the weaving department there were 17 students. These two latter departments were fitted with necessary appliances for practical work; and a good collection of dyed products, both of wool, cotton, and woven patterns, was shown to us. In the weaving room there were six hand looms, and power looms from Germany and England were promised. A self-acting mule, from Platt Brothers of Oldham, was being erected. It is to be run by a gas engine, which was also to drive some tools in the mechanical workshop.

Museum.

The museum of raw materials and patterns was extensive, and a number of mechanical models made in the school, including a set of kinematic models, were excellent.

Designing department.

The designing department attached to the school of art seemed to be well managed. The feature of the art school which most impressed us was the modelling, of which we saw some admirable time studies. In this subject 81 students had recently been examined.

A short time previous to our visit, the director of the school had taken 60 workmen to the Milan Exhibition. They formed a fund for their expenses, towards which each contributed half-a-crown (3 francs) per week.

Promoted by Signor Sella.

The chief promoter of this school, and of every good work in Biella, was the late distinguished statesman, Signor Sella, whose

factories we describe later on in the report. Signor Sella presented to the town a library of 18,000 volumes, which is kept in these premises, and is open to the public free of charge. The reading-room is also free, and we found in it several English industrial and scientific periodicals. The director pointed to the "Times," and showed us a file of this paper, going back for ten years. He particularly drew our attention to what he was pleased to term "the great English motto,"—"Time is Money,"—which is hung up in most of the class-rooms.

General Review of Continental Weaving Schools.

As to how far the realisation of the considerations, which we have laid down in the introduction to this chapter of our report, concerning the nature and extent of the work which should be carried on in these schools of art applied to weaving, have been embodied in the teaching of Continental weaving schools, we are only able to report partial and moderate success.

Schools have departed from original scheme.

Most of the schools have departed from the ideal laid down by their promoters. Qualified teachers of the highest grade have been difficult to find (there are no colleges for training them); and, where the staff is limited, those departments are neglected in which the teaching power is weak. In many schools what is called "designing" is taught, but it is only the copying and working out of designs from geometrical or other figures, supplied by the teacher, and woven by hand looms, whereas drawing as an art is neglected. In other schools, more important in size and influence, we found that instruction was given in drawing of the character above indicated, but there was no efficient teaching of *artistic* designing. In some of these schools may be found a great variety of hand and power looms, and an elaborate system for the teaching of weaving. In our opinion, the most important schools of this type are that of Chemnitz in Saxony and the spinning and weaving school of Mulhouse. Among other schools we visited of this kind were the silk weaving school at Zurich, and the weaving departments of the industrial schools of Ghent and Verviers, in Belgium, that of the commercial school of Lyons, the weaving departments of the professional schools of Lille, Rouen, Rheims, the industrial school of Rheims, and the weaving and dyeing school at Roubaix, about to be displaced by one of the most complete schools yet erected, at a cost of about 80,000*l*. Of the schools fulfilling the higher object of teaching design, in which departments of pure art exist, although in other respects not to be compared with such schools as the one at Chemnitz, we noted the weaving and dyeing schools of Biella and Como in Italy, the school of design and weaving at St. Etienne in France, and, transcending in importance all these, the weaving and dyeing schools of Vienna and of Crefeld in Rhenish Prussia. As will have been seen from our description of

Schools which teach design.

the two latter schools, they fulfil more than any others, the ideal aims of the promoters of such schools, and may fairly be cited as good examples for English imitation.

French and German weaving schools: what is taught.

With the exceptions last named, the students in French and German weaving schools are taught chiefly to execute the designs supplied to them, while many of them are not only ignorant of the art of designing, but are not even taught to draw. Without underrating the usefulness of teaching students to overcome the technical difficulty of applying designs to the loom, we are of opinion that if we aim at turning out mere adapters of patterns to new materials, we shall miss the chief purpose of these institutions and shall find ourselves, even though our schools are multiplied by ten or by a hundred, just as dependent as ever upon the small knot of Parisian designers who can think and devise, and guide the public taste.

Necessity for originality in English textile designs.

To raise the position of an industry which has been deficient, not in the trained skill of its operative weavers, but in originality, and in the blending of beauty with utility, it is clear that primary attention must be given to the application of the principles of art. If new branches of the textile industries are to be founded; if England is to take the lead in all classes of designing and weaving, it must be by the application of art to weaving. If we are content to copy others, we must be satisfied if we take a secondary place.

Textile museums.

Whilst saying this as a review of the description of Continental weaving schools, we wish to draw special attention to the importance of museums of textiles and models, as aids to the designer and weaver. For examples, we may refer to the museum of textiles and printed fabrics at Mulhouse and to the museums connected with the schools at Crefeld and Vienna.

The account of the school of chemistry and dyeing at Mulhouse and the departments for dyeing and printing of the weaving schools of Crefeld and Vienna afford information for those interested in dyeing schools in England.

(3.)—Industrial Art Schools.

Industrial Art Schools.

In this division are included such of the more important Continental art schools as have not yet been described. We have placed under one heading both the schools in which art is taught in application to a large number of industries and schools of pure art. The former class of schools, or artistic trade schools (*Kunst-Gewerbe-Schulen*), are largely represented in Germany and Austria, and even extend to Switzerland; they are, however, scarcely known in France, where a different method of teaching applied art is pursued.

We shall first shortly describe the Kunst-Gewerbe schools which we have visited in Munich, Nuremberg, Dresden, Berlin, and Vienna, and subsequently give the results of conversations which we have had with the directors of these institutions and other competent persons.

Munich Industrial Art School.

The *Munich Industrial Art School.*—This important school is located in a comparatively new and handsome building, and is complete in every particular. It was founded in 1868 as a private institution, but is now supported and controlled by the State, and is under the direction of Professor Lange, an enthusiastic advocate of industrial art teaching, who is acquainted with the South Kensington Art Schools and system of instruction, of which he speaks appreciatively. The students are admitted by examination, and must be able to draw, as elementary work is not taught.

In addition to a large theatre for lecture purposes, the school contains a great number of well-proportioned class-rooms and studios, as well as work rooms for applied work of various kinds. We can refer here only to a few of the more important departments which we visited in this school, but it will be seen from the programme, Appendix 19, Vol. V., that classes for model drawing, flower and plant painting, perspective drawing, and ornamental drawing, both for men and women, are included in the school curriculum.

Ceramic work.

In the Ceramic department a number of German potters send their apprentices to learn modelling and drawing as also painting on pottery; there is a furnace in which the students fire the ware after painting on it, as at Sèvres. A son of the largest manufacturer in Munich was painting a vase at the time of our visit. About 10 students were working in this department, each paying a fee of 20*s.* per annum. There were cabinets containing beautiful examples of pottery ware as well as designs for vases and other vessels, drawn by the pupils and the professor.

Textile designs.

In the department devoted to designing for textile fabrics, the pupils execute designs for textiles, on square-ruled paper, which are sent to the manufacturer. These designers, however, are unacquainted with the process of weaving, whilst the overlookers, who put the designs into the looms, as a rule know nothing of designing. Professor Lange naturally desires that the knowledge of these two persons should be united, so that the designer should be able to put the design into the loom, and that the weaver, who fixes the designs, should have it in his power to draw the pattern; this has been accomplished to some extent, inasmuch as art students from this school have attended the weaving schools in Passau and Münchberg. Amongst the designs in progress were some elaborate ones for the carpet manufacturers at Plauen near Dresden, and also for wall papers.

A third department is that of lithography and wood engraving; here several young men and women were drawing on stone and engraving wood blocks.

Another large room was devoted to the instruction of pupils intending to be house painters and decorators.

A special branch of the school is arranged for teaching the application of art to metal-work; here we found 20 students chasing, working-up, finishing, and preparing castings of art objects in different metals.

Another important department is that of glass painting, for which this school has become especially famous, and the students are in great demand by the glass manufacturers in the neighbourhood. Munich is well known for its coloured glass. In this branch 12 students were working, going through every detail of this industry, including the designing, the preparation and mixing of the colours, the firing, and the leading of the quarries for window glass.

In the wood carving department there were ten students engaged in very elaborate work.

Architecture is studied by a large number of young men, many rooms being set apart for this special purpose.

The Commissioners were impressed with the excellence of much of the work which is being done, and its bearings upon industry.

The Budget of this school amounts to 1,710*l.* per annum; the total number of students in 1882 was 174.

Nuremberg Industrial Art School.

The *Nuremberg Industrial Art School.*—This large school, under the direction of Professor Gnauth, is older than the foregoing; like this it is a State school, and is one which is said to have exerted a great and beneficial effect upon the art industries of Bavaria. [*See* French Report on Technical Instruction, 1863, pp. 163–4.] The tuition in this school, as seen from the drawings and applied art work shown in the Nuremberg Exhibition, is probably second to none on the Continent. About 150 students attend day classes, in addition to which there are evening classes largely attended during the winter, by the artizans of the town, especially house painters, plasterers, &c., and others who are interested in decorative work. The fees are low, being 10*s.* a half-year for Bavarians, and 18*s.* for foreigners. The school premises are not attractive or suitable; the building having been formerly a monastery. It contains, however, a very fine collection of casts, both of classical and modern works. In the modelling room, with accommodation for about 20, students were at work on floral ornament and classical examples, and this work showed a high state of proficiency on the part of the pupils; better certainly than one usually finds in the Provincial schools of art in England. The walls of the class rooms were covered with examples of ornament by the early Italian, Flemish, and Renaissance masters.

As in the Munich school, an important department, that of architecture, also exists in the Nuremberg school. The course lasts for four years, in the latter of which the students have to draw plans and elevations, calculate quantities, prepare specifications, and state in detail the cost of a building selected by the Professor; the intention being that the student at the completion of his course shall be so far acquainted with all the details of this subject as to be able, without further training, to take up the profession of an architect; whether the students have opportunities of making themselves practically acquainted with building operations does not appear.

Other important features of the school are the large collections of architectural and ornamental photographs hung on the walls, whilst an art library with books and periodicals is open to the students.

The programme of studies is found in Appendix.

The opinions of the directors of the above Bavarian schools on the subject of art instruction applied to industry will be found on page 236.

Dresden Industrial Art School.

The Dresden Industrial Art School.—This is a State institution, maintained at a cost of 2,800*l.* per annum. In connection with it is a museum of textiles and industrial art products, receiving an annual grant of 2,000*l.*, a library of art works, for which the grant is 750*l.*, and for a collection of casts 200*l.*; so that the total yearly cost to the State of the Industrial Art Establishment in Dresden is not less than 5,750*l.* The director, Professor Carl Graff, considers that the school has exerted a most important influence upon Saxon art industries. Under his care it has "introduced new industries into Dresden, and "revived decaying ones. Its work is to be found in every "shop of importance in the city, and extends to all the industries "in which art is the handmaid of industry." The Commissioners in their visit to Chemnitz had an opportunity of testing the accuracy of this statement, so far as design for textiles is concerned, in the works of one of the largest fancy manufacturers. In this establishment fancy mixed goods are manufactured, of the greatest variety of pattern and colour. These are sent largely to England, the worsted yarn having been bought in Bradford, and the cotton yarn in Manchester, although these materials pay a heavy import duty on entering Germany. In these works we saw the two head designers, and found on inquiry that they had both been trained at the Dresden Industrial Art School under Professor Graff. The manager informed us that they preferred the young Dresden designers to older ones or to those from Paris, as the former were more original, thoughtful, and tasteful than the latter. These young men from Dresden are doing well for the firm; they had a style of their own which was not an imitation of Parisian methods, the house got the advantage of being able to offer novelties and varied patterns, and hence their business prospered.

Influence of this school on industries.

The Dresden Industrial Art School is located in a large building, formerly the Polytechnic School. The ground floor is devoted to the art museum, the class-rooms and studios of the school being on the upper floors.

Number of pupils in Dresden Art School.

The number of day students in the year of our visit was 106 in the winter session and 96 in the summer. Of these 16 are poor students admitted and maintained by bursaries. About 80 pupils attend the evening classes. There are no workshops or any practical applications of design to industry in the school, and in this respect the Dresden school differs from those already described, but designs are extensively made by the pupils and sold to manufacturers for a variety of purposes. Thus we saw patterns for lace and textiles, show cards, ornamental menus, and Christmas cards, designs for porcelain, bronze, brass, and goldsmiths' work, all of which were either sold or made for sale, and the work of the students, or of students and teacher combined.

The school is divided into several special departments, thus: (1) Designing, (2) Architecture, (3) Decorative Painting, (4) Ornament, (5) Figure Drawing; Art Modelling, (6) Decorative Painting from the figure. In addition to studio work there are courses of lectures on anatomy, history of art, &c.

The Commissioners were struck with the spirit and artistic power displayed in the works of the pupils of this school. Many of the cards and smaller works of art were said to be printed and published in Berlin, and exported in large numbers to England. Interesting remarks by Professor Graff, as to his views on the teaching of industrial art, will be found in the sequel, page 241.

Art Library and Museum of Textile Patterns.

This school contains one of the most complete and valuable applied art reference libraries in Germany, including not only about 2,000 printed books, but not less than 16,000 mounted art patterns and examples, and 11,000 examples of embroidery and lace. These are all carefully catalogued under suitable headings, so that any wished-for example can be readily found. This reference library is open to the public, and is visited by 10,000 persons annually. In addition to these examples, the art museum contains a collection of 140,000 patterns of historical and other textile fabrics of all kinds and of all ages. The value of such a collection to a manufacturing community cannot be overrated.

Berlin Industrial Art School.

The Berlin Industrial Art School forms a part of the new "Victoria Institute and Museum," which owes its existence to the interest and care of the Imperial Crown Princess of Germany, who was desirous of establishing in Berlin an art museum somewhat on the plan of the South Kensington Museum, due to the initiative of her illustrious father. The school was founded by a private society, but it is now a Government institution. About one-fourth of the expenses of tuition are supplied by fees, the remainder by the State.

There are 700 students in attendance, of whom 500 are evening pupils of the artizan class. About 67 ladies attend the day classes. The fees are 36*s.* for day classes for three months, of seven hours per diem, and 1*s.* for the evening class of one hour per week for three months. Talented poor youths are admitted by exhibitions, of which 15 are provided by the State, and four by private subscription; in addition to this, the Committee of this school recommend certain students for free places. Many old pupils of the school now occupy important situations as designers in various trades in Berlin and elsewhere. The Director of the school (Dr. Ewald), gave the Commissioners his views on the mode of teaching industrial art, pointing out that, in countries where art industries are in an advanced state, the application of art to industry may safely be left to the work-shop, whereas where taste and art industries need development, the State should not only teach art, but also its application (*see* page 242). The class-rooms are numerous and well designed, and there is an ample supply of casts and apparatus. Among other departments we visited, were the room for drawing from the antique, the excellent modelling room, and several large painting-rooms, one being specially devoted to house decorators. In another class-room we found furniture designers, who were doing some excellent and original work. Less attention seemed, however, to be devoted to special applied design, than was the case in most of the other schools of this type which we visited.

Berlin Art Museum.

This school, like the one at Dresden, has the advantage of being annexed to an important industrial art museum, in which the students have every facility for study, and which is arranged with a special view to stimulate the interest of designers.

Vienna Industrial Art School.

The Vienna Industrial Art School in its general character resembles the schools already described. The building is very large and handsome, and like the art schools of Berlin and of South Kensington, it is connected with an important art museum, containing a large and varied collection of objects of art. The school, under the directorship of Dr. R. M. Belf, has been in existence for 14 years, and is a State institution, costing 4,083*l.* per annum. It consists of the following divisions:—

1. Architecture.
2. Sculpture.
3. Drawing and painting.

The latter division is sub-divided into three departments: (*a*) flower drawing; (*b*) figure painting and ornament; (*c*) designing. There are also separate departments of the sculpture division, viz., wood-carving, wood-turning, metal-chasing, and ceramic art, especially modelling for china. Students on entrance must pass an examination and must be upwards of 14 years of age. The fees are 20*s.* per semester for the preparatory school, which is carried on in another building, and 36*s.* per semester for the special schools. Many of the students are teachers in training, and several of them ladies. Much work is

done in furniture designing and in copying old models from the fine collection in the museum. Other students are occupied in pattern designing, adapted from old textile fabrics. Many attend the Vienna Weaving School, and there learn how to put their designs into the loom. An interesting instance of the influence of this school upon industry in reviving an extinct lace trade in the Erz-Gebirge was related to the Commissioners by the Director (*see* p. 244).

Revival of an extinct trade.

Ceramic art in Vienna.

In the Ceramic Department the high class porcelain painting, for which Vienna has long been renowned, is taught. The course lasts for three years; many pupils come from the potteries in the neighbourhood to learn designing and painting on china. In the morning the students design or paint, and in the afternoon they attend lectures on anatomy, the history of art, technical drawing, and style. In the third year they are taught chemistry, and the manufacture and properties of colours, and on leaving they are expected to be acquainted both with the history and the practice of the ceramic art. More than half the pupils in this department are females.

Wood-carving School.

The wood carving department was attended by 10 students, who were at work on difficult subjects, carving heads, hands, ornamental cabinet work, and figures. One of the most advanced students had nearly completed a very well executed copy of Michael Angelo's "Night" from the tomb of the Medicis. The work done here surpassed anything of the kind which can be seen in English schools, and all the students were well qualified to raise the standard of taste and execution in the shops in which they might be employed.

Metal-work.

Metal chasing and working in brass and bronze is also carried on in a separate department. Three years close application is needed to make a good chaser or finisher. After having gone through a three years' course the pupil is expected to be able (1) to make a drawing of a design for a model, (2) to make the model in clay from the drawing, (3) to cast the object in bronze or brass or other metal, and to chase and finish it, giving it the necessary expression for a finished figure, and (4) to draw the completed figure, and compare this drawing with the original design.

General Review of Continental Industrial Art Schools.

French industrial art schools.

The numerous free communal drawing classes, the drawing schools connected with the Government, and those conducted by the municipalities in various parts of France, of which we give an account under the head of Artizan's Night Schools, educate a vast number of youths as draughtsmen and designers. We cannot say that the French system, which aims rather at teaching drawing and the fine arts without special regard to the application of the same to industries, tends more than does the method

of training pursued in Germany, and to some extent that in vogue in this country, to the education of artists as distinguished from designers. The fact remains pretty much the same in all countries, that young men who really possess high artistic talent, whatever may be the nature of the art instruction they may receive, will eventually become artists, and that only a relatively small proportion of young men of ability will enter the ranks of designers, until they have found that they can only most laboriously and painfully obtain a living as painters. The really good artistic designer must, in order to be successful, be equally talented and just as highly trained as the artist painter, and it is a mistaken notion to believe that designers are as a rule failures in art.

Pure and applied art teaching.

The truth being that certain special qualifications are required by each, and opinions differ as to whether those powers which belong to the designer as distinct from the painter can be evoked by any special teaching. The best training for each, certainly, during the first few years of his career, is drawing, modelling, and painting. Not until he is thoroughly master of the various materials and processes by which art is capable of expression, and of the influence of style upon the development of the fine arts, can the student do any good by concerning himself with the varieties of design and the application of the same to industry. It is at this later period of his training when the designer can be materially benefited by placing before him well selected illustrations of what the best designers and art workers of previous periods have achieved; and it is here where the influence of industrial museums, collections of patterns, and drawings and exhibitions of art workmanship may exert a most powerful influence for good on the young designer. If at this same period we can make his work valuable to him by the actual use of what he is doing for the manufacturer or the art workman, and if we can show him further, how much more valuable his work may become to him in the future by holding out to him the hope of a profitable and honourable career, we shall present the most powerful stimulus to the creation of the future designer. The real fact is, that the dignity of the designer's work and the importance of the position he occupies, is not sufficiently acknowledged in our own country. We hold out by public exhibitions, by galleries of works of art, and by the high measure of public approbation which we accord to them, the utmost amount of recognition to the works of the painter and the sculptor, but we neglect almost entirely the work, however meritorious it may be, of the art designer. If the value of his labours were only acknowledged to the extent of some small fraction of the scale of those of his fellow worker, whom we dignify with the title of the "Artist" *par excellence*, the "artist designer" would soon take his proper rank in the country.

Means of stimulating art design.

Need of public recognition of design in England.

In foreign countries the annual exhibitions of the works of the students in schools of applied art, the "Concours," or

This is done on the Continent.

competitions, and the direct patronage by the State of certain art industries, have doubtless contributed largely to stimulate the student, and to place before him the solid advantage opened out to him by the study of design. In the middle ages the various trade guilds and the master-craftsmen encouraged and rewarded skill and excellence in designing and the execution of art works; the Meisterstücke, were openly shown and displayed to the admiring townsmen of the young craftsmen.

Action of City of London Livery Companies in stimulating design.

A part of the great wealth of the City Livery Companies could hardly, we think, be better employed than in encouraging and rewarding talented designers to produce work of the highest character. The Goldsmiths' and the Plasterers' Companies have already done much good by the prizes they have thus offered for national competition.

IV.—WOMEN'S TRADE AND PROFESSIONAL SCHOOLS.

Women's trade schools.

In nearly every country which the Commissioners visited they found, in most of the large towns, schools established for the training of girls in various industries, and these schools closely resembled one another in character. In all of them the girls are taught every variety of needlework, including plain sewing, embroidery, the making of linen underclothing, and dressmaking. The special trades taught in these schools varied in the different countries. In all of them drawing is well taught, and is the principal basis of instruction.

A very extensive series of such schools has sprung up throughout Germany, on the model of the successful Frauen-arbeitsschule at Reutlingen, the foundation of which was due mainly to Dr. v. Steinbeis. These schools in some places serve as finishing schools in which girls of the more wealthy classes acquire a knowledge of housekeeping and domestic economy after leaving the ordinary school. In Belgium, and more recently in France, schools have been established for girls, with the avowed intention of qualifying them to earn their living at various industrial pursuits. In Paris a school has quite recently been founded to accomplish for girls what has been done by the La Villette apprenticeship school for boys.

(1.) Women's Work Schools in France.

Municipal Professional and Housekeeping School.

Municipal Housekeeping School, Paris.—This school, known as the *École Professionnelle Ménagère*, is situated in the Rue Violet, 36, and has been open since the 1st May 1881. Its aim is to offer to young girls leaving the primary school the opportunity of learning some useful trade, and of giving them at the same time experience in domestic duties and

household work, thus preparing them to carry on the avocations of family life. The ordinary subjects of primary education are taught during the morning. This training serves to keep up and to strengthen the knowledge of the pupils acquired in the primary school. The special technical classes comprise a general course obligatory for all the pupils, and special technical courses suited to the profession or business which the pupil may have chosen.

Qualifications for admission.

The conditions with respect to admission are as follows: For entering the professional and housekeeping classes the girls must be at least 12 years old, and must not exceed the age of 15, and they must hold the certificate of primary instruction. As a temporary expedient, however, dispensations are granted to children who are at least 13 years of age, and who know how to read and write.

Instruction.

The school is under the direction of Madame Lajotte and a staff of teachers for needlework, sempstresses' work, fine washing, embroidery on stuffs, artificial flower-making, and stay-making. There are also special teachers for the subjects of primary instruction, for cutting out and making up dresses,* as well as for gymnastics, housekeeping, cooking, washing, ironing, &c. The pupils receive a premium proportionate to the value of the work done by them, when this work is of such a nature as to be capable of being used.

Dressmaking.

Of the trades taught, ordinary dressmaking for the working and lower middle classes appears to be the one for which there is the greatest demand. Next to this, millinery and laundry work. The least profitable is said to be artificial flower-making. All the girls take their turn at household work, including cooking.

The municipality of Paris propose to extend this school, which is situated in a quarter of the city inhabited almost exclusively by the working classes, and to establish other schools of the same kind in other similar parts of Paris.

Elisa Lemonnier schools.

Schools of the Society for the Professional Instruction of Women.—With regard to the schools conducted at Paris by the Society for the Professional Instruction of Women, the so called "Elisa Lemonnier Schools," the following facts were obtained.

These schools are four in number, situated in different parts of Paris; one in the Rue de Poitou, containing 140 pupils; a second in the Rue Duperré, with 220 pupils; a third in the Rue d'Assas, with 95 pupils; and a fourth in the Rue des Boulets, with 80 pupils.

They are managed by a society, under distinguished patronage, and are supported to a considerable extent by public sub-

* Madame Scheffer, one of the Inspectrices des Écoles Communales de Paris, has prepared a manual of cutting out for schools, which was handed to the Commissioners.

scription. The annual expenditure on their maintenance amounts to about 5,000*l*; this cost being partly borne by subscriptions, partly by legacies, and partly by contributions of 240*l*. from the Minister of Commerce, an equal sum from the Minister of Public Instruction, and 800*l*. from the city of Paris. The private subscriptions amount to about 680*l*., and an annual fancy sale produces about 2,400*l*.

Course of instruction in Elisa Lemonnier schools.

The teaching is specially intended to prepare young girls for commercial life and for various industries. Day scholars only are received, who must be at least 12 years of age, and must pass a preliminary examination. The course extends over three years, and is divided into general classes and special classes. The general classes give a sound elementary instruction in the French language and literature, arithmetic, geometry, history, geography, natural sciences, and writing. The special classes are six in number, (1) a commercial class, including book-keeping and English language; (2) industrial drawing; (3) dressmaking; (4) wood engraving; (5) painting on pottery and porcelain; and (6) painting on glass. The entrance examination, which relates only to the general classes, includes a knowledge of the elements of French grammar and arithmetic.

Certificates awarded.

At the end of each year a committee of examiners undertakes to inspect the work done and to award certificates of proficiency.

School hours.

The school is open in the winter from 8.30 a.m. to 6 p.m., and in summer from 8 a.m. to 6 p.m. The literary instruction is given from 8 to 11 in the morning; the special classes take place in the afternoon from 12 to 6. The school fees amount to 12 francs per month (9*s*. 7*d*.), which are payable in advance on the 1st of each month.

Schools conducted by a company.

These schools were established under the presidency of Madame Elisa Lemonnier in 1856, and they appear to have been attended with very considerable success. The society which now conducts them was incorporated on the 14th January 1870. It is of the nature of a limited company divided into shares of 2*l*. each, but there is also a large body of subscribers paying 1*l*. per annum. The society is under the management of various committees, and has generally a lady of station as president, together with vice-presidents, treasurer, secretary, &c.

Commercial school for girls, Paris.

École Commerciale pour les Jeunes Filles, Paris.—This is a middle class girls' school, established in 1871, and situated at 26, Rue Ganneron. It is under the superintendence of Madame Paulin, and receives a subvention from the City of Paris. The instruction aims at giving girls a knowledge of some trade or business, a sound general education being at the same time imparted. The mornings, from 8.30 to 11.30, are devoted to general instruction, and the afternoons, from 12.30 to 5.30, to special (professional) work. The school consists of four divisions, a preparatory class in two sections, and first, second, and third

year students. There are 150 pupils, all of whom learn drawing at least once a week.

Professional instruction.

The classes having a special professional character are four in number: (1st) a commercial class in three divisions, including the study of English, and elementary civil and commercial law; (2nd) a class of industrial drawing, which includes water-colour, flat-tinting, painting on porcelain and pottery; (3rd) a class of millinery (lingerie) and dressmaking; and (4th) a class for the training of governesses preparing for the Hôtel de Ville examination for diploma. From a circular handed to the Commissioners it appears that the girls from this school have taken a large number of diplomas, and in four different years a pupil of this school has taken the prize for having been first in the annual examination for the diploma.

Staff.

Plan of instruction.

There are, under the directress, five female teachers and six masters, counting the teacher of gymnastics. The rudiments of science are taught to some of the pupils. All the girls are taught vocal music, and all have 1½ hours daily of plain needlework. The time is so sub-divided during the morning lessons that none of them are over an hour in length. The girls receive good and bad marks in books supplied them for the purpose, and a weekly report is made to the parents. The Commissioners were not favourably impressed by this institution. The school buildings are ill-adapted for the purpose. The class rooms were badly ventilated, and the drawing class was doing indifferent work in a conservatory.

Professional school for girls, Rouen.

École Professionnelle Communale des Jeunes Filles, Rouen.— This is attended by girls from the age of 12 to 15, and the instruction is designed to qualify them to become useful and efficient wives for men of the working class. On the second floor is a laundry where the smaller articles of linen are washed and got up; work being taken in from families in the neighbourhood. On the upper floor the girls are taught dress-making; in the first year they learn plain sewing, and in the second and third years cutting-out and making dresses. Embroidery is taught, and the girls work from sketches made on the blackboard. Cookery is likewise practically taught. The school is simply a day-school; it is attended by 89 pupils, and the instruction is wholly gratuitous.

(2.) Women's Work Schools in Germany.

Women's work at Reutlingen.

The Women's Work School, Reutlingen, Wurtemberg.—This school, founded in 1868, was the first of its kind in Germany. The Frauenarbeitsschule, an imposing building of four storeys, occupies an excellent situation on the outskirts of the town, and has gardens back and front. The class rooms are lofty and well lighted, and the sanitary arrangements seemed very good; the present school building was completed in 1877. The Commissioners, under the guidance of the headmistress,

Madame Bach, first visited a museum at the top of the building, containing a complete collection of the various kinds of work done in the school, arranged in sequence from the simplest sewing to needlework of the most ornate character, embracing almost every variety of needlework, lace, and embroidery. Dressmaking of all kinds appears also to be well taught, and as many of the girls come here for a year, on leaving the higher girls' school, to complete their education as housewives, the classes for cutting out work and dressmaking are well attended.

Many girls come here also to be educated as teachers of needlework, and 188 mistresses have already been trained in this school. The girls who are in training as teachers willingly accept commissions for various kinds of work through the headmistress. Drawing is well taught, and is the foundation of all the various kinds of work. Each course of work lasts for 11 weeks, but, in order to become thoroughly proficient, two courses, or 22 weeks in each subject, are required. Schoolmistresses must remain for two years to learn needlework thoroughly.

In the machine work department all the girls have their own sewing machines.

Ironing and clear-starching are practically taught; also, pleating, &c. For Programme, *see* Appendix 11, Vol. V.

This school was well represented at the Stuttgart Exhibition, and a number of frames hung round the museum gave an excellent idea of the work of the school. The total number of students was 238, and there were 21 teachers. The fees are about 8*l.* per annum, payable quarterly.

Women's Work School at Munich.

Frauenarbeitsschule at Munich.—The Commissioners also visited the Women's Work School at Munich. This school, opened in 1873, was founded on the model of the school previously described. The girls, before being admitted, have to bring their certificate from the Volksschule, or Primary School. This school is not a State school, but is supported by private means. It is organized and managed by a Society for the Amelioration of the Condition of the Working Classes. It receives some assistance, by way of grant, from the town. This school is not exclusively an industrial or professional school, in which, as in other schools of the same kind, women are trained to earn their living, as a large number of girls come here who receive instruction in needlework for domestic purposes only, and there is a special department for training schoolmistresses. The pupils of the school are taught freehand, linear, and perspective drawing, and also designing for embroidery patterns. They likewise receive instruction in German, arithmetic, bookkeeping, &c. The only practical instruction, in addition to that in drawing, is the instruction in needlework, which is taught in all its branches, and the girls learn every kind of embroidery and dressmaking. The Commissioners had the opportunity of inspecting several beautiful pieces of work which were intended

for the Nuremberg Exhibition. The school is housed in what was originally a convent.

The fees are 36*s.* a year for ordinary pupils, and 72*s.* for mistresses in training. There were 439 of the former, and 39 of the latter, frequenting the school in 1881.

(3.) Women's Work Schools in Austria.

Embroidery School, Vienna.

Royal State School for Art Embroidery at Vienna (Fachschule für Kunststickerei).—This is a State school for girls, many of whom afterwards become teachers, and go to other countries. The directress is Frau Emilie Bach, whose books on the subject of embroidery have become standard works. There are 70 to 80 pupils, under the charge of seven teachers, and the complete course extends over five years. The instruction is free, and there are also bursaries, which enable the poorer pupils to live whilst receiving the instruction in this school. Girls seeking admission must be not less than 14 years of age, and must have completed their education at the primary school. They must be able to draw, and have a thorough knowledge of plain needlework. All the pupils are taught freehand drawing. Lectures are given by professors, and of these the girls have to prepare written accounts. The students make designs for needlework, and trace them on to the material. Every kind of fancy needlework and designing for needlework is taught. At the end of each year the girls have to work a sampler or diploma work to show their proficiency. The walls are covered with designs worked by the pupils. Foreigners pay 25*l.* per annum for the complete course of instruction, and auditors can be received on payment of 2*l.* 10*s.* per half-year. The single course can be taken in two years. The instruction here was perhaps the most advanced we met with in any school of this character. An excellent school of the same type was likewise visited at Berlin.

(4.) Women's Work Schools in Belgium.

Girls' professional school, Brussels.

Brussels Professional School for Girls.—Schools not materially differing in character from many of those already described are the two "Écoles Professionnelles pour Jeunes Filles" at Brussels, one of which is of a somewhat lower grade than the other. The Commissioners visited the higher grade school, intended for the education of the daughters of shopkeepers and parents of the bourgeois class. The waiting room, which was being used as an examination room, was prettily decorated with panels and plates painted by the students. The basis of the instruction in this school is drawing, which underlies all the special trade work which the pupils are taught. The teaching comprises a general course, which is obligatory on all the pupils, and

Drawing obligatory.

special courses in preparation for various trades. The general courses are intended to carry forward the education received at the primary schools, and embrace French, arithmetic, history and geography, the elements of natural science, laws of health and domestic economy, writing, drawing, singing, and gymnastics. The trade courses comprise lessons in book-keeping, the application of arithmetic to commercial occupations, English or German language and business correspondence, applied art, dressmaking, embroidery, &c. The school is for day pupils only, who are not admitted below the age of 12 years. Pupils who do not enter the school with bursaries, of which there are a considerable number, pay 2*l.* 8*s.* per annum, which is about one half of the cost of each pupil, the remaining expenses being defrayed by private donations, the produce of the sale of work done in the school, and the subventions of the commune and of the State.*

Value of drawing for dressmakers.

The Commissioners particularly noticed the extent to which the teaching of drawing is made the basis of instruction in such subjects as that of dressmaking. In the department of dressmaking the girls were allowed to receive orders from their friends or others, which they executed in the school. At the time of the Commissioners' visit there was a competition in dress and costume making, on the results of which prizes were awarded. These competition costumes were inspected by the Commissioners.

Artificial flower making, Brussels School.

One of the principal trades taught is the making of artificial flowers. Formerly, nearly all the artificial flowers were made in France, but recently, and mainly owing to the introduction of schools of this kind, not only is a sufficient supply made in Belgium for home consumption, but likewise to some extent for export. The girls were working in separate divisions, each representing a year's work. In the first year they learn to make petals of all kinds; in the second year, buds; and in the third year complete flowers, roses, &c., and competition groups, for which prizes are awarded. The materials from which the flowers are fabricated are supplied by a contractor having a shop in the town, who gives gratuitous instruction and sells for his own benefit the flowers made by the girls. We may note that, although the trade is carried on to a large extent in London, our imports of these articles amounted in 1881 to nearly 500,000*l.*

Large importation into England.

China painting, &c.

Another interesting department of applied art in this school is that devoted to technical painting. In a room situated at the extremity of the building were a number of girls, some of whom were engaged in painting on china and glass, others on silk for decorative purposes, and others again were employed in painting fans.

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* *See* Table of Professional and Industrial Schools in Belgium, Appendix 9, Vol. V.

In this, as in all the similar schools of Belgium, a certain number of the pupils are educated to make designs for the Brussels lace, which is chiefly made in convent schools by children under conditions said by some of the authorities to be prejudicia to their health and welfare. Lace designing.

On the top floor of the building was a large and well arranged art studio. Art studio.

Six schools on this model exist in Belgium, of which those of Liége and Antwerp were likewise inspected by the Commissioners, and found to be equally efficient with that already described. The Commissioners were much impressed with the excellence of the organisation of these schools. The subject of the technical and higher instruction of women is now receiving considerable attention in Belgium, to which full reference is made in some of the recent writings of M. Trasenster and M. E. de Laveleye. Other schools of a similar kind in Belgium.

(5.) Women's Work Schools in Holland.

Amsterdam Girls' Industrial School. [Industrie School voor Vrouwelijke Jeugd.]—This institution, founded by the two sections of the Society "Du bien public," was established in 1865. It is under the direction of a committee presided over by M. W. Van der Vliet, Miss A. Mijné being the directress. Amsterdam girls' school.

The age for admission is from 12 to 16, and the necessary qualification is the instruction obtained in the primary school. The subjects taught are Dutch language and history, geography, writing and arithmetic, geometry, chemistry, and physics. The students pay 2*l.* 2*s.* per annum. The aims of the institution, which has lately been housed in a new building, are to train teachers for infant schools; to prepare candidates for the Government examinations in drawing, plain and fancy needlework, and the dispensing of drugs; and to impart a knowledge of art in its industrial applications, such as leather work, flower making, wood carving, and lace making.

The teaching is individual, and the ordinary course extends over three years. Course of instruction.

The first is preparatory; the second includes manual work and the theory of the arts bearing on particular industries; the third, study of the special industrial occupations selected, which may, if desired, be continued during a fourth year.

The entrance examinations take place in May and November.

The school contains about 158 pupils, 30 of the first year, 55 of the second, and 73 of the third year. There are seven masters and five mistresses; also two assistant teachers, former students of the school. Number of pupils and teachers.

There are 34 hours of instruction given per week, namely, daily from 9 to 4, with an hour for dinner, from 1 to 2, and on Saturdays from 9 to 1. The students of the first year

receive literary instruction with 12 hours of drawing and 12 hours of needlework weekly; in the second year the course embraces eight hours of literary instruction, 10 hours of drawing, and 16 hours of needlework. In the third year the course varies according to the occupation selected; there are four hours of literary instruction, except for the apothecary students, who have eight. The general students have eight hours of drawing, the apothecaries only two, and from 18 to 20 hours of needlework or industrial work, except for the apothecary students, who have but 14 hours of industrial work and eight hours of pharmacy.

Instruction in pharmacy.

The school budget amounts to about 1,300*l.* per annum.

The school is supported partly by the above-named society, partly by a Government grant of 375*l.*, and subsidies from the town; also by subscriptions and by the fees, which latter, together with the sale of work, produce about 453*l.* per annum.

(6.) Women's Work Schools in Italy.

Female professional school, Milan.

The Female Professional School, Milan.—The Scuola Professionale Femminile at Milan is an interesting type of schools in which special instruction in other branches of industry besides needlework is given, whilst that of the ordinary school subjects, is further developed. The girls are received into it direct from the primary schools, and many of them after completing only the obligatory course of two years. Others have passed through the entire course of four years.

Course of instruction.

The school is supported mainly by subscriptions, but the municipality contributes 120*l.*, the province 200*l.*, and the Government 120*l.* annually to its maintenance. It trains about 150 pupils, who pay from 4 f. to 5 f. per month. Special instruction is given in dressmaking, flower-making, embroidery, china painting, telegraphy, and typography. The pupils are taught to use sewing machines of various kinds. All sorts of fancy work are done by machine. The dressmaking class executes orders for ladies' dresses. In the embroidery class the work is of a very high order of merit, and the patterns are nearly all original and designed by the pupils themselves.

Class for study of telegraphy.

A class for teaching telegraphy appeared to be very successful. The pupils receive instruction in the elementary principles of electricity and chemistry from a professor of a Technical Institute who visits the school. An employé from the telegraphic department gives instruction in the manipulation of the instruments, and a lady teacher attached to the class superintends the daily practice of the pupils. In a small room devoted to this purpose was a working telegraphic instrument, apparatus for simple experiments, and diagrams showing the course of the current and the systems of notation. The systems of Morse and Hughes are taught at a later period of this course. The pupils, before being

employed in the telegraphic department, are sent to an office for further practice. The pupils learn both French and German.

In the china painting class there were eight pupils. Besides painting on pottery, the girls were employed in painting on glass, to imitate Bohemian glass. In the decoration, china clay was employed, and the glass was afterwards fired. The ornamentation was in white, red, and gold. It was said that a course of four or five years enabled a girl fresh from the primary school to become fairly expert as a china painter. The girls drew from nature on paper, and copied these drawings or paintings on the china. Another section of the school is devoted to the teaching of printing in colours. Some trade jealousy exists against those who are learning typography, but in spite of it the girls succeed in obtaining employment; in this department 18 girls were engaged. The yearly report of the school is composed and printed by the pupils themselves.

Class for painting on china.

Class for colour printing.

Printing.

The teaching of drawing in this school, under the direction of an art professor, was excellent. The freehand drawing, even in its earlier stages, is made to illustrate different styles of art. There was a collection of outline copies showing examples in Roman, Greek, Egyptian, Persian, and other styles, some of which were coloured. The pupils appeared to take great interest in these lessons. The designs were the work of the professor and were not for sale.

Teaching of drawing.

The girls on leaving the school are said to earn a fair amount of wages. A good embroiderer can earn as much as 3 fcs. a day, and one who works in colours 4 fcs. a day. Those who paint on china can gain 4 to 6 fcs. a day; florists 2 to 5 fcs. Many of the girls continue their occupations after marriage, and thereby add to the family earnings.

Private schools such as this are subject to inspection with regard to hygienic arrangements only, but not as regards the character of the instruction given.

General Review of Women's Trade Schools.

There are certain features common to nearly all the women's schools described in the preceding sections. They are intended generally for the daughters of small shopkeepers and of the upper class of artizans, and in most of them the primary education of the children is continued and supplemented by instruction in one foreign language and in drawing, in addition to the special technical teaching which they provide. The pupils may be regarded in a certain sense as half-timers; for the morning hours are usually devoted to the teaching of ordinary school subjects, whilst the afternoon is given up to the learning of a trade. The character of the special technical teaching depends very much upon the social habits of the people of each country. Whilst

General review of women's trade schools.

needlework and dressmaking form the principal subjects of instruction in nearly all these schools, book-keeping, the elements of law, and commercial correspondence are taught in many of the schools in France, where young women are more frequently employed as accountants and overseers in commercial houses than is the case in other countries. In both Germany and Austria, where women are more commonly employed in domestic industries, the technical instruction is almost entirely confined to plain sewing, embroidery, dressmaking, millinery, laundry-work, and cooking. In Belgium, Holland, and Italy, the education in women's trade schools embraces a wider range of subjects, and includes artificial flower making, lace designing, painting on fans, on porcelain, and on glass, typography, telegraphy, and pharmacy. In all these schools great attention is given to drawing, as underlying all the industries in which special instruction is given. Many of the pupils in these schools pay tolerably high fees for instruction. A few children are admitted by means of exhibitions from the elementary schools. A careful examination of these schools shows that the education they afford aims at and generally succeeds in being very practical, and enables many young women to find suitable and remunerative employment, which, if it does not serve to entirely maintain them, enables them, without leaving their homes, to supplement the family income.

Ordinary and technical instruction are combined in foreign schools.

The connection of ordinary with trade instruction is one of the special characteristics of the education afforded in foreign technical schools, and this is particularly marked, and is attended with special advantages, in the case of girls' schools. In many of our large towns the experiment of establishing a middle class or second grade technical school for girls, somewhat on the lines of the École professionnelle pour jeunes filles at Brussels, might be usefully tried. In such a school the morning hours would be devoted to the study of languages, drawing, arithmetic, and the elements of science, and the afternoons would be occupied with practical instruction in some industry. More attention might with advantage be given in this country to instruction in plain and fancy needlework, dressmaking, and millinery. Abroad, as here, girls have access to the art schools, although it is doubtful whether these schools on the Continent are so largely attended by female students as in this country.

V.—HIGHER TECHNICAL INSTRUCTION FOR EMPLOYERS, MANAGERS, &c.

Higher Technical Instruction.

We now pass on to the last section of this part of the Report, in which we have described some of the institutions, found in the several continental countries, for imparting the highest technical education.

These schools may be dealt with in the following order:—

I. École Centrale, Paris.

II. Polytechnic School of Paris and the Higher Schools of France.

III. The Polytechnic Schools of Zurich, Munich, Vienna, Stuttgart, Dresden, Hanover, Carlsruhe, Aachen, Berlin, Delft, and Moscow, and the Mining School of Freiberg in Saxony.

École Centrale des Arts et Manufactures, Paris.

I. *The École Centrale des Arts et Manufactures of Paris.*—This important and well known institution is designed to prepare students for the professions of civil and mechanical engineering, metallurgy, and manufacturing chemistry. It was founded in the year 1826, chiefly through the interest of M. Dumas, (whose recent death science has to deplore), and is essentially a private and self-supporting establishment, not receiving any grant from Government, and depending entirely on the fees of the pupils, thus standing in striking contrast to other similar institutions on the continent. It has, however, lately been attached to the Ministry of Agriculture and Commerce. The annual receipts amount to 20,640*l.*, and the disbursements to about 17,836*l.*, the difference being paid over to the new building fund. The school is at present located in an old building in the Rue des Coutures St. Gervais, totally inadequate to its needs, but it is shortly to be transferred to splendid premises about to be built near the Conservatoire des Arts et Metiers, chiefly at the Government expense, though partly also at that of the school.*

There is a very strict entrance examination and great competition for the vacant places; of the 540 candidates who applied in the year 1881 only 220 were admitted. None of the students are boarded in the establishment.

Course.

The regular course extends over three years (see Appendix, No. 16, Vol. V., for prospectus),† and diplomas are given to the students at the end of the course, after passing a very severe examination and working out a thesis. A strict system of continuous examination and marking is carried out, the work which each student does being entered carefully by each examiner, and the results of the whole three years' work are added up; the special grade of the diploma being given according to the result of this system of marking.

The first year's course consists of instruction in general science, without much applied science, and is similar to that given in the École Polytechnique, whilst in the second and third years the teaching is especially directed to applied science, and is similar to that given in the École des Mines. The later instruction has special reference to the practical applications of each subject. The student who fails to gain his diploma at the end of the third year,

* We have heard lately that these new buildings are not being proceeded with so rapidly as we were led to expect when we visited the school.

† A detailed programme of all the courses of the École Centrale is published by J. Dejey, 18 Rue de la Perle.

may pass the examination without re-entering the school, at any period within six years after leaving the institution.

The peculiarity of the education of this school is, that the instruction is much the same for all students, and that there is scarcely any specialization of the studies in accordance with the proposed career of the student. The difference is mainly shown, as hereafter explained, in the thesis or "*projet*" which the student prepares during the last year.

Fees. Staff.

Each of the 600 students pays 32*l.* per year, and the governing body of the school manages the whole of its financial and other concerns. There are 30 professors attached to the institution, the chiefs of departments receiving 300*l.* per annum, the others 4*l.* for each hour of lecture. In addition there are two directors of studies and 30 tutors and assistant lecturers. The students on leaving the school, and after having gone through its very severe discipline, are glad to get situations of 72*l.* to 80*l.* per year. The Director, M. Solignac, (whose salary is 400*l.* per annum), furnished the Commissioners with a list of the present positions of all the pupils since the beginning of the school.* A large number of manufacturers send their sons to the École Centrale.

Theses at the École Centrale.

One of the most interesting features in the scheme of education in the École Centrale is the system of theses, which are written by the students at the end of their third year. The courses of instruction on which the theses are founded are divided into mechanics, metallurgy, technical chemistry, and engineering. Each student takes up one or other of these subjects for his thesis, as he deems fit, although the three years' course of instruction is not confined to any one of these branches, but comprises the subjects of all. The Commissioners inspected several of the theses of the outgoing students of former years, in each of the above departments, and were much struck with the detailed character of the work, and especially with the completeness of the drawings. The students are allowed to work at home, but have to produce the calculations, descriptions, and drawings, within one month from the time at which the subject is given out, and the whole work is carefully examined by a council of professors, the student being examined on the details of his thesis.

One of the metallurgical theses which was examined was a plan and estimate for a blast-furnace plant. This included the quantity and composition of the raw material to be treated, the chemical composition of the charges, the explanation of the changes which take place in the furnace, the cost per ton of the pig-iron produced, the price of the raw material being given; then the construction of the plant, the hydraulic lifts and blowing engines, the reservoirs, the engine-houses, the hot-blast regenerating stoves, including

* See the Annual of the Friendly Association of Old Students of the School from 1832–1880, published by the Association at the École Centrale in the Rue des Coutures St. Gervais, giving an account of the employment and position of all the old pupils of the school.

a discussion of the amount of heat generated in the furnace, and regenerated in the Whitwell stoves.

The Director of the school furnished the Commission with a copy of a thesis on the "Manufacture of Sulphuric Acid" by M. * * * *, one of the outgoing students.

This paper contains full details, both theoretical and practical, concerning the method of manufacturing sulphuric acid. The aim of the essay is to lay down the exact conditions under which the successful manufacture can be carried on, and to show that the writer has mastered all the minutiæ of the processes, as well as of the construction and arrangement of the necessary plant.

The memoir is accompanied by complete, elaborate, and well executed detailed drawings of the apparatus, buildings, &c. of a sulphuric acid works. During the preparation of these essays the pupils are permitted to obtain information from books or from any other source.

The difficulty of giving, in a course of lectures, detailed practical instruction of a kind to enable a student to write an essay on a manufacturing subject is so great that it appeared desirable to obtain the opinion of some well qualified manufacturer, as to how far the conditions necessary for a successful practical issue had been fulfilled in the essay itself.

Opinions on value of thesis.

The accompanying extracts from a letter from a well known English manufacturer, clearly indicate that whilst the essay shows a lack of such detailed information as can only be gained by intimate practical acquaintance with the manufacture itself, yet it is a very creditable performance, and that a system of instruction of which this is the outcome, is of great value as a preparation for the actual work of the manufactory.

"I have carefully perused the manuscript essay by M. * * * * and felt very much interested in it. I think I can safely say, it indicates such knowledge as a course of a few years at the École Centrale and some select books would supply, supplemented by visits to chemical works. There is however nothing in the paper which shows any intimate acquaintance with the manufacture. If the author had been thoroughly acquainted with it, he would have found it necessary, for example, to provide more than six Glover towers, or more lead pans for concentrating his acid. He has entirely overlooked the fact that he has to use some Glover towers to denitrate his Gay-Lussac vitriol. His method of placing the boilers and their foundation would also, I think, be objected to. But all these things only go to show that the paper is the result of theoretical studies, and as such it is fairly good. He is a good draughtsman, knows how to calculate strength of apparatus, wheels, &c., and though the paper is full of mistakes, it clearly demonstrates the value of the system of education, if a man can do these things after having passed the course of lectures."

"I felt, however, a little disappointed with the results of those portions which are essentially chemical. But, of course, the paper is a sample of what the school is designed to do, and the system

must not be judged by the mistakes of the thesis of a pupil, except in so far as they point to the fact that after all a man cannot be good at everything. This particular pupil seems to have had a better taste for the mechanical portions of the subject than for the chemical ones."

"His analytical chemistry also shows want of judgment. But, as already stated, the memoir proves that M. * * * * has had a good education, is fit to enter a works, and make himself useful, and the paper, I think, indicates, in spite of the many mistakes, that the system of education is a good one. Though it seems that for a speciality chemist there has been too much time spent upon engineering and too little on chemistry. In conclusion I may repeat my opinion that the essay is the result of theoretical teaching, not of practical work, and as such is very good."

Teaching of chemistry at the École Centrale.

An investigation of the method of teaching chemistry in the École Centrale, including an inspection of the laboratories, proved that the arrangements are at present extremely insufficient for instruction in the higher branches of either theoretical or applied chemistry; and an examination of the course which the students undergo, shows that it can by no means be said to be a high or extended system of instruction. Hence the students of the École Centrale, who desire to become chemical manufacturers, or who wish to continue their studies after leaving the École, pass into one of the private laboratories of Paris, or into that of M. Fremy, in the Jardin des Plantes. Indeed, the opinion was expressed to us that there is at present no means in Paris by which a finished chemical education can be given to a student, as it can be given to a certain extent in England, and to a much larger extent in Germany. This opinion is shared by most of the younger chemists in Paris, as we learned by conversation with them. We may, however, mention that the inadequacy of the laboratory accommodation in Paris will be to some extent remedied by the erection of the large new École de Médecine which is now approaching completion, and also by the projected new buildings of the École Centrale, to which reference has been made. Mention should also be made of the splendid new École de Pharmacie, which is certainly the finest of its kind, and to which we in England have no corresponding institution.

Present condition of chemical education in France.

M. Fremy's laboratory.

The Chemical Laboratory of M. Fremy, situated in the Jardin des Plantes, in the Rue Buffon, is among the best of the students' laboratories at present existing in Paris, accommodation being provided for 30 to 40 students. Many of his pupils are the sons of manufacturers, or former students of the École Centrale who have come to complete their chemical education. The course is free, and the cost of materials is defrayed by the State. M. Fremy is an ardent admirer of the system of the École Polytechnique, which he believes to be the greatest teaching institution in the whole of France. It does not appear, however, that even in his laboratory, the students obtain anything more than a comparatively elementary knowledge of chemistry, and their instruction does not seem to go beyond ordinary quantitative analysis.

M. Lauth's published statement on the insufficiency of chemical training in France.

The prejudicial effect which the acknowledged want of a high and extended system of training in chemistry produces on the trade of France, is a subject which has attracted much attention, and which is discussed most clearly in the report of the jury for Class 47 in the Exhibition of 1878.* M. Lauth, who is now Director of the Sèvres works, points out on page 11, as an illustration of the injury which this want of chemical training has done, that the discovery of artificial alizarine has altogether destroyed the cultivation of the madder-root, and that this is a disaster for certain of the French departments, and one almost without compensation for France, as the discovery of the artificial production of alizarine was made in Germany, and that country remains the centre of its manufacture. He thinks that the indifference with which the madder growers regarded the progress of modern chemistry, and the conservative way in which they followed only the steps of their fathers, has, at any rate, done much to render the disaster complete. He shows that whilst in 1872 the amount of madder grown in France amounted to about 25 millions of kilograms, it had diminished in 1878–9 to less than half a million, the price being at the first period 70 to 80 fcs. per 100 kilos., and having fallen to 20, and even to 14 fcs., so that the cultivation becomes financially impossible, whilst the actual production of artificial alizarine, on the other hand, corresponds to 30 millions of kilos. of madder-root. Considering, in the same way, other instances of French chemical industry, he says it would be puerile to dispute that many of the French industries have suffered cruelly, and if in former times France has shown an initiative power and a real sagacity in research, the last decennial period has been unfavourable to the trade. This falling off he attributes to several causes, some of them purely material, arising from the excessive taxation to which the country is now subject. Other deeper-lying causes are to be ascribed to the present actual state of legislation on patent law, and to the insufficient development given in France to scientific studies.

With regard to the question of taxation, he shows that almost the whole of the raw materials used in chemical industries are heavily taxed, whilst a number of manufactured products are allowed to enter France free from such duties. He also points out that the patent laws in France require re-modelling, and he comes to the conclusion that the only satisfactory condition of things would be that an international patent law should be established with the purpose of protecting the inventor. Without such a law,† or without a convention to arrange such matters, the patent which "gives up our discoveries to a stranger, and which gives alms to

* Of this jury one of your Commissioners was Vice-President, and M. Chas. Lauth, Secretary.

† It is to be hoped that the resolutions arrived at by the International Congress on Patent Laws, which are being gradually adopted by the various Industrial States, will apply a partial remedy for this evil. Several of the principal European States and Brazil have entered into the Convention, and the entrance of the United Kingdom, which the Patent Act of 1883 authorises, will not be long delayed.

" our neighbour, is only a deception." The last point, which concerns this Commission more nearly, is the question of chemical education in France. M. Lauth feels so strongly on this subject that he addressed a letter to a late Minister of Agriculture and Commerce, M. Teisserenc De Bort, which he prints in extenso in his report. In this letter he points out that although there are at least 25 chemical laboratories in Paris, and although the Directors of these laboratories are highly distinguished men, yet hardly any of these can be said to be institutions for the training of students. The professors pursue their scientific discoveries, their demonstrators assist them in their experiments, they are occupied in public lectures, and they give the rest of their time to private research. The students work without any distinct aim ; there is in some laboratories a certain amount of tutorial instruction, given either by the professor or the chief of the laboratory, but there the instruction ends. These laboratories are very excellent for those who are already chemists, but are insufficient for those who wish to become chemists. Neither the Conservatoire, nor the École Centrale, accomplishes the end in view. Chemical industries are assuming more and more a scientific character; a chemical works is nothing more than a large laboratory in which the victory remains to those who are most scientifically educated, and he adds that this shows the absolute necessity of the foundation of a national school of chemistry in France. He thinks that the course should be one of three years, and that a competitive examination should confer upon the deserving student the title to a diploma of chemical engineer. For a school of 60 students, 20 in each year's course, he thinks one professor, one director, and three assistants would be sufficient. In support of his argument he states that evidence is not wanting that the chemical industry of France is seriously menaced, and he instances the ammonia-soda process, which was first successfully carried out in Belgium, and the regeneration of manganese, carried out in England by Mr. Weldon, as two discoveries which have revolutionized the greatest of chemical industries—that of the alkali trade. He likewise refers to the fact, already mentioned, of the ruin of the French madder-growing trade from the German discovery and manufacture of artificial alizarine, and he states that the constant progress which foreigners have made in the preparation of aniline colours, is a daily menace to the few French houses that carry on that industry. He adds that this state of things cannot be too strongly recognized, because " patriotism " consists, not in concealing faults, but in correcting them," and all this he believes is chiefly due to one cause, the want of properly educated chemists.

Opinion of a French dyer on the subject.

In corroboration of these opinions of M. Lauth, the following opinion expressed to the Commissioners by a leading French dyer, may be quoted. Being asked why new colours are produced almost exclusively in Germany, he explained that these colours were first manufactured in Lyons and patented. They were imitated in Germany and in other countries where the invention

was not protected by patents, and where they were consequently made more cheaply. Trade monopoly in France during the duration of the patent practically prevented any improvement in France, whereas in other countries where no patent existed, everyone tried to make improvements, and so other countries got ahead of France. This, however, he added, would not have been the case, but that in other countries, more especially in Germany, there are numerous laboratories in which young chemists are methodically trained in great numbers, there being, he regretted to say, nothing of the kind in France; even the École Centrale, though an excellent school, was not a first-rate chemical school, and indeed he could not point to any school in France in which a young man could get the same instruction in chemistry which he would obtain in any of the great University and Polytechnic laboratories of Germany.*

École Polytechnique, Paris.

II. *The École Polytechnique of Paris.*—This is a Government school, with military discipline, designed primarily for the education of persons to be employed in the service of the State, and differing in this respect from the Polytechnic Schools of Germany and Switzerland. Hence it does not fall so directly within the scope of the Commission as do the other Paris schools.

But although this school was specially created and is still maintained with the object of training engineers and others for the service of the Government, it is not without influence on the industries of France, because a few of the pupils on leaving school at once enter into private undertakings, whilst many, who were originally Government servants, on retirement, enter into manufacturing concerns. Moreover, the inspection of the enormous amount of work done by private firms for the Government is performed by these engineers.

The instruction is of a very advanced character, and it is necessary to have passed through this school before admittance can be obtained into the practical schools of the Government, such as those of the Génie, the Artillérie, and the Ponts et Chaussées. The same applies to students entering the École des Mines, if they wish to become mining engineers under the Government. The High School of Telegraphy, recently established, is also partly recruited from students of the Polytechnic School, and others enter the Government tobacco manufactory, the dockyards, the marine artillery, &c., &c.

The numbers have increased very much of late in consequence of the great extension of Government employment since the Franco-German war. Before that event the annual admissions were from 130 to 140; now they average 220. On completion of their

* This unfavourable estimate of the chemical industries, and more especially as to the preparation of colouring matters from coal tar in France, is, however, not universally entertained. We refer on this subject to an interesting article on "La Houille et les matières Colorantes" by M. Denys Cochin in the *Revue des Deux Mondes* of February 1884.

course, about 70 pass into the artillery school, 40 into the École du Génie (engineers), 30 to 32 into the École des Ponts et Chaussées (railways, roads, bridges, &c.), 4 or 5 into the École des Mines, and about 10 directly into private industries. The age of admission is between 16 and 20 years. The course of instruction extends over two years. The cost, including board, is 40*l.* per annum, besides 32*l.* for the two years for "outfit (trousseau) and breakages." There is a preliminary qualifying, and a subsequent competitive entrance examination. In 1881 there were 1,183 candidates, reduced by the preliminary examination to 433, of whom 220 were finally admitted by competition.

École Polytechnique, fees.

Course.

The course (see time table, &c. in Appendix 20, Vol. V.,) comprises mathematics, which is the principal subject taught, physics, chemistry, drawing, military instruction, military exercises, and riding. The hours of study are 11 daily, those of recreation 3½ (the students rise at 6.30 a.m. and retire at 9.0 p.m.). The library (containing many rare works, all of which are accessible to the students) is excellent. The physical apparatus is very complete; the chemical apparatus fairly good.

Not one in a thousand of the students, except in case of death or other unavoidable cause, fails to complete his two years' regular course. If from some reasonable cause a student is prevented passing the examination required for entrance on the second year's course, a third year is allowed. About one-half of the students hold scholarships, most of which cover the entire cost of education and outfit. Should a student, owing to family misfortunes, be unable to pay the second year's fee, there is never any difficulty in obtaining assistance.

Scholarships.

The scholarships (*bourses*) are supplied chiefly by the State; a few by endowments, legacies, and by the Departments.

They are generally awarded as follows:—The municipality presents; the prefect of the Department confirms; the council of the school reports to the Minister of War, who decides.

Budget.

The ordinary budget of the school is—

	£	
For salaries - - - -	22,000	per annum.
Other expenses, including board of students - - - -	38,000	„
	£60,000	

which, divided by, say, 430 students, equals about 140*l.* per student. This is exclusive of buildings. At the present time about 96,000*l.* are being spent on the erection of physical laboratories, and large extensions are in contemplation.

The professors are men of high reputation. They receive salaries of 400*l.* per annum, and are at liberty to teach elsewhere. The tutors receive 100*l.* per annum and their board.*

École des Mines.

The *École des Mines*, Paris, which is a branch of the École Polytechnique, admits students who are not necessarily destined for Government service. The Commissioners visited this school under the guidance of Professor Daubrée, the director of the institution, and Professor Friedel, who has charge of the celebrated collection of minerals in this school. Two classes of students are admitted, who may be termed respectively, regular and occasional students. Practical instruction is given in all the departments relating to mining; but especially in metallurgical operations and chemical analysis. The laboratories, though not very extensive, are well arranged and well appointed. The Government students are admitted from the Polytechnic School. External pupils have to pass a competitive examination,† and the successful candidates are trained to become directors of mines and metallurgical works. The course of study lasts three years, the instruction is gratuitous, and the curriculum is thoroughly adapted to the object in view‡. The instruction is of the highest kind, and in some respects it resembles that of the Royal School of Mines, South Kensington.

School of Ponts et Chaussées.

Amongst the higher technical schools of Paris, the *École des Ponts et Chaussées* must be mentioned, which serves for the training of civil engineers for the service of the State. Its resident students are supplied by the Polytechnic School, but external pupils, whether native or foreign, may also be received. The instruction is gratuitous, and the course lasts from November to June, and extends over three years.

In the summer the pupils are sent on missions into the departments, and attached to works in process of construction.

Higher educational institutions of France.

The Higher French Educational Institutes.—The higher educational institutions of Paris, viz., that of the *University* (*Sorbonne*), the *Collége de France*, the *École de Médecine*, the *École de Pharmacie*, and the *École de Droit*, as well as the provincial universities or academies, and the *École des Hautes Études*, are mainly devoted to the training of persons destined for the learned professions or for special branches which are scarcely cognate to the inquiry of the Commission. Many of these institutions have been already dealt with by former Commissions. The last mentioned, however, will be described in another part of the report, as it is a unique institution, which has for its object the furthering of original scientific research in France, the results of which have already exerted a remarkable influence on industrial pursuits.

* The course of the École des Mines is three years; of the Ponts et Chaussées, three years; of the Artillérie, two years; of the Génie, two years; of the École Supérieure de Télégraphie, two years. This last named school, which is quite new, has about 15 students. The course comprises general telegraphy and independent research. It is recruited, partly (as stated above) direct from the École Polytechnique, and partly by competition amongst old polytechnic students and employés of the telegraphic service, possessing competent theoretical knowledge.

† *See* the Programme d'Admission aux Cours Préparatoires in Appendix 21, Vol. V.

‡ A complete programme of the courses, printed by the National Printing Press, and published in 1878, was handed to the Commissioners.

III. Polytechnic Schools or Technical Universities of Germany, &c.

Origin of Polytechnic schools.

The great impulse which was given to engineering and manufactures some 40 or 50 years ago by the formation of railways and the establishment of factories throughout Europe, and the demand which arose for highly skilled assistants, owing to the widespread introduction of the steam-engine and other mechanical inventions depending upon it, gave rise in Germany and Switzerland to the creation of High Schools, in which the necessary scientific training with its practical applications could be imparted, so that by this means a body of men might be educated in such a way as to make it possible for Continental states to compete with the work-shop trained engineers of England.

The numerous Universities of Germany did not furnish instruction of a sufficiently practical character, nor were their authorities willing to admit within their walls a class of men who would be likely to devote themselves especially to industrial pursuits: nor, again, would they lower or alter the standard required from University students on entrance, as ascertained by the "leaving examination" of the classical school. Moreover, they did not care to permit of any system of fixed curricula and examinations in lieu of their accustomed plan of *Lehr und Lern Freiheit.* It must also be remembered, moreover, that at this time the practical teaching, even of the pure physical sciences, was only in its infancy in the University.

The requirements for instruction adapted to the necessities of the time became so urgent that each State vied with the others in the extent and magnificence of its buildings for Polytechnic Schools, as also in the grants voted for the maintenance of those institutions.

List of principal Polytechnics.

The following is a list of the principal schools:—

(1.) The Federal Polytechnic School of Zurich.*
(2.) The Polytechnic School at Munich.
(3.) The Polytechnic School at Vienna.
(4.) The Polytechnic School at Stuttgart.
(5.) The Polytechnic School at Dresden.
(6.) The Polytechnic School at Hanover.
(7.) The Polytechnic School at Carlsruhe.
(8.) The Polytechnic School at Aachen (Aix-la-Chapelle).
(9.) The Technical High School of Berlin (for which a new building is now in course of erection at Charlottenburg).
(10.) The Polytechnic School, Delft.
(11.) The Polytechnic School of Moscow.

These schools have been built at a cost of not less than three millions sterling, and are maintained at an annual cost of over 200,000*l.*

* Another term for "Polytechnic" is Technical High School, which is equivalent in English to Technical University.

We proceed to give a few particulars respecting these institutions, all of which, with the exception of that at Moscow, have been visited by the Commissioners.

Zurich Polytechnic.

(1.) *The Zurich Polytechnic School.*—The Federal Polytechnic School of Zurich, which is one of the largest as well as one of the most successful of its kind, was established by the Swiss Confederation in 1854, and the building has since been considerably enlarged and extended. This noble edifice forms one of the principal features of Zurich, standing on a commanding eminence above the city. The institution comprises seven special schools.

Divisions.

(1.) The architectural school, with 3 years' course.
(2.) The civil engineering school, with 3½ years' course.
(3.) The mechanical engineering school, with 3 years' course.
(4.) The school of chemical technology (including pharmacy), with 3 years' course.
(5.) The school of agriculture and forestry, forming 2 sub-sections, with a course of 2½ years.
(6.) The normal school, destined to educate special teachers for mathematics and natural science, also forming 2 sub-sections.
(7.) School of philosophical and political science.

Preparatory course.

In addition to these, there is a preparatory mathematical course, for those students who are not able to pass the entrance examination required in this subject, to admit them to any one of the above courses.

The Commissioners were received by the President, Dr. C. Kappeler, who explained to them the regulations of entry, the division of the subjects, the mode of election of the professors, and the government of the institution. They were then shown over the building by Director Geiser, the professor of applied mathematics, and were also conducted over the various departments by the several directors, amongst whom were Dr. Victor Meyer, professor of theoretical chemistry and director of the theoretical laboratory, Dr. Lunge, the professor of applied chemistry, and Dr. Weber, the professor of physics.

Courses. Staff.

To give an idea of the completeness and extent of this institution, it will be sufficient to state that there are upwards of 200 distinct courses of lectures, given by 45 professors and 13 assistants, not counting the tutors, the curators of the museums, and the servants employed in the establishment.

Many names, well known in science and literature, have been in the past, or are at present connected with this great institution.

Budget.

The budget of the school is as follows :— *

	£
Annual federal subvention - -	13,880
Annual subvention of the canton of Zurich -	640
Subvention of the canton and the town of Zurich for the purposes of the natural history collection - - -	176
Fees paid by students - - -	3,794

* In 1876.

The total annual expenditure being a little under 20,000*l.*

In addition to this, a considerable sum has been bequeathed to the institution, amounting to a total of nearly 20,000*l.*, and within the last few months, a sum of 50,000*l.* has been voted by the Federal Council for the extension of the Chemical Laboratories.

In the Appendix (No. 17, Vol. V.,) will be found a detailed programme for the winter semester, 1883–4.

The regular students must have attained the age of 18, and must either produce certificates of good conduct, and of having passed through the necessary preliminary studies, or must undergo an entrance examination, producing specimens of their own drawing. There were in the winter semester of the year 1880–81, 488 students and 253 auditors, total, 741; and in the year 1881–82 the total number was 685.

Zurich Polytechnic, fees.

For a complete course of instruction in any one department the fee is 4*l.* for the semester. The winter semester lasts from October to March, and the summer semester from April to August. In addition, 2*l.* is charged for each of the laboratories in the winter semester and 1*l.* 16*s.* in the summer. Thus the total cost to a student in the chemical department, including laboratory practice, does not exceed 12*l.* per annum.

Civil engineering.

The Department of Civil Engineering at the Zurich Polytechnic, is one of the most important in the school, and was founded in the year 1855, together with the schools of mechanical engineering and chemistry.

The course of instruction extends over a period of three and a half years (seven sessions), and begins each year in October.

Entrance examination and regulations.

For admission to this department the candidate has to pass an examination in mathematics, mechanics, physics, and drawing, or to show certificates from a former school that he possesses the required proficiency in these subjects. Intending students may enter either as regular students (Schüler) or as auditors (Zuhörer). The former are bound to attend all the obligatory courses of lectures, and pay 4*l.* as the fee for the whole year; auditors can obtain permission from the professors to attend the courses they wish, and pay a fee of four shillings a session for each lecture or hour's drawing they attend in a week. The great difference in the expense makes the number of auditors very small.

Nature of instruction.

The first three sessions are occupied almost entirely with theoretical subjects, such as pure mathematics (differential and integral calculus, differential equations, and higher analytical geometry), descriptive geometry, with drawing, mechanics and physics treated mathematically. These subjects are attended also by the students of the Mathematical School, and are, in the opinion of some, rather too exhaustively treated for students of engineering. For instance, the descriptive geometry course extends over three sessions, with three or four lectures a week, and includes four hours' obligatory drawing per week for the first two sessions. The four hours' drawing per week is insufficient to

finish the problems given, and often 15 to 20 hours in a week have to be spent in solving problems in descriptive geometry. The theories expounded in the third session are of a still more advanced character.

Besides these subjects there are in the first three sessions several short courses on more practical subjects, *e.g.*, elementary architecture, petrology, applied geology, chemistry of building materials, and surveying and surveying instruments.

In the fourth session the lectures on graphical statics are commenced, a knowledge of which is very important in bridge-designing. The system of teaching statics mainly by geometrical construction has hitherto been little employed in England and France in practical designing, but is well known in Germany and Italy.

The last two years of the course include lectures on various branches of engineering, tunnels, stone and iron bridges, railways, canals, roads, geodesy, &c., besides a great amount of drawing and designing in these subjects. There are also courses of practical surveying, and astronomy, with observatory practice.

In all the subjects there are from time to time, usually weekly, short *vivâ voce* examinations, and problems are set to be solved out of hours, so that the system of teaching is very thorough. Diplomas of proficiency are given to students who pass the special examinations held at the end of the fourth and the seventh sessions.

Numbers.

The average number of students in civil engineering is about 110, and is a great falling-off from the number in the years 1870–77, which averaged about 260. The fact that the number of non-Swiss students is about 70 per cent. of the whole is a proof of the wide-spread reputation of the school. The foreigners are from all parts of Europe, especially Austria and Hungary, as well as from North and South America (Brazil).

Museums and collections.

An important feature of the institution is the number and variety of the laboratories, libraries, museums, and collections of apparatus and objects of scientific and artistic interest, which the institution possesses, of which the following is a list:—

1. Several libraries—(*a*) belonging to the school, (*b*) to the canton, and (*c*) to the town of Zurich. These latter have been placed at the service of the students.
2. Various collections belonging to the engineering and architectural divisions, consisting of models, instruments, &c.
3. A collection of plaster casts of architectural ornaments.
4. „ „ specimens of construction and of materials used in building.
5. „ „ antique vases.
6. „ „ engravings, about 24,000 in number.
7. „ „ geometrical instruments.
8. „ „ models of machinery.
9. „ „ tools and models for the section of applied mechanical technology.

10. A collection of models and raw and finished products for the section of chemical technology.
11. „ „ mathematical and geometrical models.
12. „ „ interesting specimens, tools, &c., relating to forestry.
13. „ „ models, implements, and produce in all departments of agriculture.
14. Collections of specimens relating to natural history, zoology, botany, mineralogy, geology, palæontology, and entomology.
15. An archæological collection.
16. A workshop for moulding and casting in clay and plaster.
17. „ „ metal work.
18. Laboratories for instruction in theoretical and applied chemistry.
19. A special laboratory for agricultural chemistry.
20. A cabinet of physical apparatus and a physical laboratory.
21. An institute of vegetable physiology, comprising a room for microscopic researches, a physiological laboratory, botanical collections, and hothouses.
22. A botanical garden, with a museum for the general and botanical collections.

No manual instruction of a mechanical character.

In common with the Polytechnic Schools of Germany, there is no manual instruction in workmanship of a mechanical character.

Pure and applied chemistry.

The practical instruction in each department is of a strictly scientific nature. Thus, for example, in chemistry, the instruction given in Prof. Victor Meyer's laboratory is identical with that given in the University laboratories of Germany. But after passing through the course of pure chemistry, including both laboratory practice and lectures, the student may proceed to the classes and laboratory work of the professor of applied chemistry, Dr. Lunge; the practical work consisting chiefly in the preparation of chemical products. The laboratories both of physics and of chemistry are antiquated, and are altogether insufficient for the present requirements of the students. Large extensions in this respect are about to be made, the sums voted for this purpose amounting, as already stated, to 50,000*l.*

Physics.

The remark which has been made with regard to chemistry applies also to the physical teaching, namely, that the instruction is not specially adapted to any particular industrial work, but is of a general and purely scientific character. In some of the Polytechnic Schools, notably in Munich and in Stuttgart, practical laboratory instruction in physics has only been recently introduced, and as yet on a small scale: even in these cases the instruction is strictly scientific and is not specially adapted to any branch of electrical engineering, or to any other industry to which a knowledge of physics might be applied. In Dr. Weber's physical laboratory at Zurich, it is true, a small number of students receive practical instruction in exact electrical measurements, in testing of resistances, &c., but no courses of a technical character have

at present been introduced into this department of the Polytechnic.

This renowned school has from its very commencement endeavoured to impart the greatest possible extent of scientific instruction in each of its departments, and its efforts have been to direct thought and research of the highest kind in their applications to industrial pursuits, and thus to bring about the necessary mutual interchange of ideas between science and practice; and it has been so far successful that students have come to it from all parts of the world. The Commissioners had the opportunity of judging of the advantages which it has bestowed, not only upon Switzerland, but also upon Germany, by the number of thoroughly trained scientific men who have been educated within its walls and who are now holding important positions in various industrial establishments which the Commissioners have visited. Influence of the Zurich Polytechnic School.

(2.) *The Technical High School of Munich.*—The Munich Polytechnic School is housed in magnificent buildings, erected at a cost of 157,000*l.*, whilst the cost of the various collections was 36,390*l.* The annual expense of maintenance, without reference to interest on the capital account, is 20,000*l.* Munich Technical High School.

The Commissioners visited this fine institution under the guidance of Director von Bauernfeind.

The students are divided into two classes, the regular or matriculated, and the occasional students. The regular students are admitted only on passing a special examination, or on bringing a certificate of having passed through the Industrie Schule, the Real Gymnasium, or the Gymnasium proper, and must be 17 years of age. The special examination for those who do not bring a certificate from one of the above-mentioned schools, comprises the German and French languages, mathematics, including the elements of algebra, geometry, and trigonometry, and drawing, both freehand and mechanical. Regulations for entrance.

The institution consists of six special schools, as follows:— Divisions of the school.

(1.) The General School.
(2.) The Civil Engineering School.
(3.) The Building School.
(4.) The Mechanical Engineering School.
(5.) The Industrial Chemical School.
(6.) The Agricultural School.

The instruction consists of lectures, laboratory work, and drawing, and in its general character resembles that of Zurich.

A special feature of the German Technical High Schools, and the same of course is the case with the Universities, is the great sub-division of such general subjects as engineering, architecture, and chemistry, each special branch of the subject being placed in the hands of a separate professor. Thus, for example, the number of distinct courses of lectures, given under the engineering department at this school, is 45, and the number of professors giving these is 13; and attached to the three engineering depart- Great sub-division of the courses in each subject.

ments, namely, the civil, the mechanical, and the architectural, are 17 professors. There are in all 179 courses mentioned in the programme.

This distribution of the teaching amongst professors, each of whom is specially conversant with the details of some portion of his subject, is in striking contrast with the English system, in which the instruction is generally placed under the direction of one professor as head of the department, assisted by two or three lecturers or subordinate teachers. The large number of professors attached to each department is another indication of the ample supply of highly educated men, available as teachers, always to be found in Germany.

Course for technical chemists, Munich Technical School.

The chemical school, which was at the time of our visit under the direction of Prof. Erlenmeyer, is, as in Zurich, a school of pure chemistry, where the highest branches of inorganic and organic chemistry are pursued, but at the same time there is a special course for technical chemists, for details of which see Appendix,* No. 18, Vol. V.

The great point of distinction between the instruction to chemists, as given in the Polytechnic, and that given in the German Universities, is the addition, in the former case, of drawing, and instruction in the general principles of mechanism and of mechanical technology, in addition to the special technical chemical subjects; and this course is undoubtedly valuable to those about to be engaged in the application of chemistry to industrial pursuits, and the advantage of this system to chemical engineering cannot be overrated.

Practical instruction in physics.

The remarks already made as regards the physical teaching at Zurich apply to that in this institution, under the direction of Professor Beetz. A very good beginning is here being made towards giving practical laboratory instruction in physics, for which no accommodation was made in the original construction of the building. This instruction is consequently carried on in what was intended for the corridor leading to the physical department. In this corridor a series of desks are fixed, each mounted with special apparatus, the student passing from one to the other in regular course, and performing himself the several experiments for which each apparatus is designed.

Engineering school.

Perhaps the most interesting and important section of this Polytechnic is the engineering school. This department consists of numerous rooms for instruction in mechanical drawing, of large collections of models, and of laboratories for special practical work. To give an idea of its extent, it may be stated that it contains six large rooms, used exclusively for machine drawing, of which one is furnished with 100 tables. The collection includes kinematic and other mechanical models, models of machines and parts of machines, and raw and finished products. There is also a collection of minerals, &c.

* These courses are for students coming from Real Gymnasia or from Upper Real schools. The course is slightly different in the 1st and 2nd years for students from Gymnasia.

Mechanical laboratory.

The laboratories or mechanical workshops, under the direction of Prof. Bauschinger, contain a compound steam-engine, having complete appliances for registering the various degrees of expansion and the power developed. Another laboratory is furnished with a very expensive testing machine, by Ludwig Werder, working up to 100 tons, for determining strains and the modulus of elasticity of different substances. All experimental results are carefully tabulated by the students, and recorded in books. In addition to numerous tests of varieties of wood, stone, and other building materials, a series of investigations is made to ascertain constants, to verify formulæ, and to test the strength of metal of various sections, including tests for torsion, tension, compression, &c. There are also arrangements for obtaining the most delicate micrometric measurements, and for experiments on long continued concussion as affecting the fibre of bars of metal. There is a museum of the specimens which have resulted from the foregoing experiments; and diagrams have been prepared by the students to show in a graphic form the outcome of the different tests. This laboratory was founded in 1868, and was the earliest of its kind on the Continent, and this was the first instance in which practical instruction of the above nature was attempted at a Polytechnic School. The laboratory, besides the valuable instruction it has afforded to students at the school, has been largely utilised by manufacturers and others, both in Bavaria and throughout Germany, who send materials to be tested.

Diminution of numbers in the engineering department, and its cause.

Both the chemical and physical departments of this school were found by the Commissioners to be overcrowded, and already too small for the number of students at present receiving instruction and desiring admission. The same remark does not apply to the engineering department, in which provision was originally made for a very large number of engineers, the demand for whom in consequence of the approach to completion of the railway system throughout Europe, is gradually falling off. The cause of this diminution has attracted a large amount of attention in Germany, and has been the subject of many pamphlets and discussions, the fact being that the number of engineers passing out from the various technical schools far exceeds the present demand for such persons in after-life, one estimate making the number of students annually trained to be 1,000 in excess of the demand. The Commissioners were informed that the manager of a large engineering works had been so importuned by the constant application of polytechnic students for employment in his works that he put up a notice in his window "No polytechnic students need apply."

Influence of this on the universities.

The re-action from the over supply of engineers has benefited the Universities, which are consequently more frequented, throwing the young men into the learned professions; but a counter re-action is expected to follow, and signs of it in Germany are

said to exist, there being, according to one estimate, at the present moment, 4,000 duly qualified lawyers in Germany, having no employment whatever.

Attendance in several departments, Munich.

The total number of students in attendance at the Munich Polytechnic for the year 1881 was 901 in the winter and 809 in the summer semester, whereas in 1878, there were 1,194 in the winter and 1,012 in the summer semester, whilst in the engineering school the numbers were 272 in the winter and 247 in the summer of the year 1878, as against 118 in the winter and 114 in the summer in the year 1881.

Visits to industrial establishments.

In addition to the 30 different collections existing in this school, the pupils have the privilege of visiting other valuable collections and museums in the city. As an important feature of the instruction here, as in other similar Polytechnics, we may mention the frequent visits made to the industrial establishments of the district, in company with, and under the guidance of, the professors of the several departments.

Fees.

The entrance fee for each student is 10*s.*, the fee per lecture is 2*s.* 6*d.* per semester for each hour's lecture per week, and 1*s.* 6*d.* ditto for practical work; and for attendance and for consumption of materials in the laboratory 1*s.* extra. The total outlay of the Munich Polytechnic School for the year 1881–2 was 20,028*l.*

Vienna Technical School.

(3.) *The Technical High School of Vienna.*—At the Vienna Technical High School the Commissioners were received by the Rector, Ritter von Hauffe. This institution is housed in large and commodious buildings, and consists of the usual arrangement of drawing rooms, chemical laboratories, and engineering collections. There is nothing specially to be noticed in this institution as differing from others. The Rector stated his opinion that the preliminary education given in the Real Gymnasia of Austria, as preparatory to the polytechnic training, was not so satisfactory as that given in the classical Gymnasia, and he informed the Commissioners that it was the intention of the Government to suppress the former of these classes of schools.

Separate dyeing school in Vienna.

As an illustration of the fact that the Polytechnics on the Continent do not give what is understood in England by an industrial technical training, it may be mentioned that a separate school for Dyeing* has just been established by the Nieder-oesterreichischer Gewerbe-Verein in Vienna, which receives students after they have completed their course at the Polytechnic school.

The Polytechnic School at Stuttgart.

(4.) *Polytechnic School at Stuttgart.*—This, which is one of the oldest polytechnic institutions of Germany, was considerably extended in 1879, as much as 75,000*l.* having been spent on the addition of two new wings.

Dr. v. Fehling on teaching of technical chemistry.

Dr. von Fehling, the professor of chemistry, who conducted the Commissioners over the building, expressed very strongly his opinion that there was really no distinction to be drawn between

* *See* Weaving School at Vienna, p. 145.

the teaching of general chemistry, and of what is commonly understood as technical chemistry; that is to say, that the man who is thoroughly qualified as a scientific chemist, and has spent a sufficient time in the study of the subject, having passed through a complete course of theoretical and practical instruction, is fully qualified, when he enters any chemical manufactory, to apply his knowledge to the special industry in which he may have to be engaged. On the other hand, Dr. Marks, the professor of chemical technology at the same institution, whilst admitting the great necessity to every manufacturing chemist of a thorough knowledge of the principles of the science, attached considerable value to instruction, such as was given in his department, consisting to a great extent of lectures on the machinery and other appliances used in special chemical manufactures, and on methods of research in their application to special branches of chemical industry. He considered that the manufacturing success of the Germans, both in chemistry and in other industries, had been almost entirely due to the high scientific education which they received, principally at the polytechnic schools, by means of which they were able successfully to compete with the English, notwithstanding the superior advantages which the English people possessed in their coal and iron fields.

Dr. Marks on the same.

The physical department of this Polytechnic is under the direction of Dr. Zeck, who has recently introduced laboratory practice for students into his teaching. He has drawn up and printed for their use a series of graduated practical exercises which they are themselves required to carry out in the laboratory. In consequence of the very recent developments of electricity in its industrial applications, the number of students in the physical department of this Polytechnic has lately somewhat increased. At present this school is very badly supplied with the means of practical work on a large scale. The school possesses no steam engine, and the dynamo, used for experimental purposes in the physical department, is worked by a small water motor. Indeed nothing is more remarkable, in passing through the several departments of such a Polytechnic as that of Stuttgart, than the complete absence of anything like practical instruction, beyond such as is found in the chemical and to a small extent also in the physical laboratory. The number of students attending the lectures on physics is about 200, of whom not more than 30 work in the laboratory.

Physical department.

In this school there are 26 heads of departments, and 14 assistant teachers, together with 25 assistants, making altogether a teaching staff of 65.

Staff.

The number of pupils in this as in other Polytechnics has fallen off in recent years, mainly in consequence, as has already been stated, of the completion of the railway system on the Continent.

Attendance.

An important department of this school is the architectural division under Professor Reinhardt. The Commissioners were shown the

Architectural division.

drawing rooms, which are on a very extensive scale, and there were 120 students going through a course which extends over there years. A noteworthy feature of the instruction is that an annual journey is undertaken by the professor with about 20 students, who go to Italy, or to some distant country, and measure and draw a series of buildings. The drawings are autographed and are annually published by a Berlin firm.

Attendance at Stuttgart Polytechnic.

The number of students attending the winter session of 1880–1 was 458, of whom 258 belonged to the state of Wurtemberg, and 200 were foreign students. The total expenditure in the year ending April 1, 1881, was 14,861*l.*, the receipts from all sources were 2,000*l.*, and the State subsidy 12,861*l.*

Polytechnic School at Dresden.

(5.) *Dresden Polytechnic School.*—The Commissioners visited this school under the guidance of the Rector, Professor Zeuner, well known for his work on the mechanical theory of heat. This school is the Technical High School for the Kingdom of Saxony. It is housed in new and commodious premises, forming one of the most striking buildings in the town. It was founded in the year 1851, and the school entered in 1875 into its new buildings, standing on a square plot fronting the Bismarck Platz, and having an area of 12,157 square metres. The chief building contains spacious drawing rooms, physical laboratories, class rooms, reception rooms, and offices, whilst the chemical laboratories are situated in a distinct building, at the back of the square. There are no less than 95 separate rooms in the three floors of the main building, whilst the block devoted to the chemical laboratory contains 31 rooms of various sizes.

Departments.

The institution comprises four schools:

(1.) Mechanical engineering.
(2.) Civil engineering.
(3.) Chemical technology.
(4.) Mathematical and physical science.

In addition to the departments above mentioned, a normal school for teachers is attached to this Polytechnic.

An important division of the Dresden school is the physical department under Professor Toepler. The laboratory appeared to the Commissioners to be one of the most complete they had seen, and was arranged with great care and attention.

The chemical laboratories under Professor Schmitt, who takes the pure chemistry, and Professor Hempel, who takes the technical chemistry, are also well arranged.

The remark which has been made with respect to the diminution of the number of students applies to this as to other Polytechnic schools.

Professor Zeuner on influence of Polytechnic instruction in engineering.

Professor Zeuner stated that the main object of Polytechnic instruction in engineering is to make the students acquainted with the scientific principles underlying the construction of machines and engineering works, and to enable them to understand and appreciate every new invention or discovery when it comes

before them, and with this object all inventions involving new principles are brought under the notice of the students and discussed by the professor.

As regards the influence of this instruction on the industries of the country, he considered that the whole mechanical industry of the Germans was the result of the superior education of the people; that whereas, formerly, they purchased locomotives from abroad, they now use exclusively those made in Germany, and that all their great industrial works were filled with polytechnic students occupying posts of managers, directors, &c. For example, in the works of Krauss, of Munich, who had recently turned out his 1,000th engine, all the engineers are old students of Professor Zeuner himself, who was formerly director of the Munich Polytechnic. So, too, at Kessler's in Esslingen, all the heads of departments are former polytechnic students.

Whilst he was unable to cite any case in which the polytechnic instruction had brought Germany in advance of England in any one branch of engineering, Professor Zeuner believed that without the education which these schools provide, the German engineering industry would be in a very inferior position to that which it now occupies, and that the Germans would be unable to produce, as they now can, the greater part of the machinery they use, and even to export some. The Professor, whilst recognising the ability and skill of German engineers, freely acknowledged his great indebtedness to the works and influence of Rankine, who is regarded as the greatest authority on mechanical science in all the chief engineering schools of Germany, and whose books and researches are much used in Germany.

Zeuner on Rankine's work.

The number of students in the year 1880–1 was 473.

The annual cost of the school for the year ending December 1880, was 13,457*l.*, of which the State contributed 12,203*l.*

(6.) *The Polytechnic School at Hanover.* — The Polytechnic at Hanover was formerly located in a small building in the town, but has recently been removed to the magnificent Welfenschloss, which was being erected as a palace for the late King of Hanover at the time of the Austro-Prussian war. The building was subsequently altered and adapted to the purposes of a polytechnic school at a cost of 100,000*l.*, the total cost being 350,000*l.* It was opened in the year 1879.

The Polytechnic School at Hanover.

The school of mechanical engineering is the most important department of this Polytechnic, which contains in all 14 lecture rooms with places for 1551 students, whilst the drawing rooms are fitted with 673 tables, and can accommodate 896 pupils.

Mechanical engineering department.

The chemical laboratories are new and very complete as regards their arrangements, but they are considerably smaller than the laboratories found in other Polytechnics.

The physical department is of minor importance, scarcely any practical work being done by the students.

Collections.

The collections of mechanical models, of raw materials, and of products, are very extensive, and occupy a large part of the building. These collections have cost 36,000*l.* and are maintained at an annual expenditure of 1,250*l.*

Engineering and architecture.

In the department of engineering and architecture, plans of important buildings constructed in Germany are critically examined and discussed by the professors, with a view of explaining to the students the points of merit in these designs, or suggesting their possible improvement.

The Polytechnic school at Carlsruhe.

(7.) *The Polytechnic School at Carlsruhe.*—The Carlsruhe Polytechnic is the Technical High School for the Grand Duchy of Baden, which has in addition two Universities, those of Heidelberg and Freiberg. It was founded in 1836, and the building was much enlarged in 1863. The physical and chemical laboratories are at the back in a separate building. This is the oldest of the German Polytechnics. The Black Forest forming a large portion of the Grand Duchy of Baden, this Polytechnic has a school of forestry forming the sixth division of the school.

There are 11 collections, including a fine and extensive collection of forest products. The professors are 41 in number, with 12 assistants, and there are 350 students; the number having very much diminished in recent years.

The courses of instruction and the various departmental buildings are of the same character as those already described, and do not merit special notice.

The Polytechnic school at Aachen.

(8.) *The Polytechnic School at Aachen.*—The Polytechnic of Aachen (Aix-la-Chapelle) stands in the same relation to the University of Bonn as the Polytechnic of Carlsruhe does to the Heidelberg University. It consists of a very magnificent building, completed and opened in 1870, to which subsequently in the year 1878 a very important chemical laboratory was added, standing as a separate building, the cost of which alone was 45,000*l.* The number of students in this Polytechnic has fallen off more than in any of those previously described. A few years ago there were 500 regular students in attendance, whereas at the present time there are only about 110. Recently, since the appointment of the new director, Geheimrath Gieziky, the number of students has again begun to increase.

At Aachen they are beginning to adopt the system which prevails at the Universities, of giving more freedom and latitude to the students in the choice of the subjects of instruction than is usual in the other Polytechnic schools.

This Polytechnic contains six large lecture halls, besides numerous class rooms. It has in all 21 collections, including a museum of geology and mineralogy, of mechanical technology, and models of machines and instruments used in the different manufacturing processes of the neighbourhood. It has, besides this, a large room devoted to the reception and preservation of specifications of patents.

The physical department again calls for little comment, not being especially remarkable. Physics.

The new chemical laboratory was erected a few years since, under the direction of Professor Landolt, now of Berlin, in consequence of the original laboratory in the old building, having at that time, become too small for the requirements of the pupils. It consists of two separate departments, one for organic chemistry, and one for inorganic chemistry, that for inorganic chemistry comprising two distinct laboratories, the one devoted to qualitative and the other to quantitive analysis. These laboratories are most elaborately fitted, each student's place being furnished not only with gas and water, but with an exhaust filter apparatus, with a vacuum, with steam, and with an air blast. The number of students has at present fallen lamentably low. Chemical laboratory

The courses of chemical technology are especially devoted to the chemistry of the iron and steel manufacture, with a view of preparing students for the mining and iron industries of the Westphalian district. Great importance is attached here, as elsewhere, to the combination with the teaching of technical chemistry of instruction in engineering and drawing, and the construction of the engines and apparatus used in manufacturing processes. Frequent visits are paid by the professors, in company with the students, to the numerous and rapidly increasing mining and iron industries and other manufactures of Westphalia. Technological chemistry.

It was stated by some persons that, whilst the chemists trained in the Polytechnic generally become industrial chemists, managers of works, or chemical engineers, those trained in the University, although very frequently employed in factories, do not, as a rule, rise beyond the position of analysts or foremen. This is, however, a statement requiring considerable qualification, as will be seen from our final remarks on the schools of this division.

(9.) *The Technical High School at Berlin.* — This school, when it was visited by the Commissioners, was in a somewhat transitional state, as magnificent new buildings are in course of erection for it at Charlottenburg, and the various departments are now, owing to want of space, rather disconnected and badly accommodated. The technical high school at Berlin.

There are five principal divisions: Divisions.

1. Architecture, presided over by Professor Jacobsthal.
2. Civil engineering, presided over by Professor Schlichting.
3. Mechanical engineering, presided over by Professor Meyer.
4. Chemistry, presided over by Professor Liebermann.
5. Applied sciences, presided over by Professor Paalzow.

The third of these divisions has a sub-section for shipbuilding. The complete course extends over four years, except in the section for shipbuilding, which has a three years' course.

Department for practical tests, Berlin.

Attached to the school is the Royal Mechanical Testing Institution, and the establishment for experiments on building materials. The former of these departments is in two divisions, the one for continuous and protracted experiments with the apparatus of Woehler; the other to investigate questions of direct public interest by experiments for the Government and for private individuals, on the strength of materials, &c. The latter branch of the establishment includes, besides the apparatus for testing metals, devices for conducting tests of the strength and other properties of all descriptions of artificial stones, freestones, cements, limes, &c. To both of these institutions the students have, as far as possible, every facility of access, in order to witness and to take part in the experiments.

Collections.

The Polytechnic possesses numerous fine collections, suitable for the instruction of the various classes of students; prominent among which may be placed the magnificent series of kinematic models, prepared under the direction of Professor Reuleaux. This collection was shown to the Commissioners by the professor, who explained to them the system upon which the models had been designed and arranged.

Workshops.

In connection with the mechanical engineering department are workshops, under the charge of Professor Consentius, in which the apparatus for the school is prepared, and the students are afforded an opportunity of becoming practically acquainted with the use of tools. There is a shop for metal work, another for wood-work, and a third for the making of diagrams and models for teaching. The students pay 15 shillings per semester for the privilege of working in the shops, but it did not appear that many of the students occupied themselves with practical work.

Woehler testing machinery.

The Woehler testing machines are arranged for investigating the strength of metal bars and rods, subjected during long periods of time to blows, torsion, and flexure. Each of the machines has counters attached, and some of the test bars had already been stretched, bent, or twisted many millions of times, without apparent injury.

New building at Charlottenburg.

A visit was paid to the new buildings in progress at Charlottenburg, a beautiful suburb of Berlin. The new High School, which was in an advanced stage of progress, will be the largest establishment of this kind on the continent.

Laboratory.

The chemical laboratory is contained in an isolated building.

The cost of the new Polytechnic building is estimated at 450,000*l.*, and when it is remembered that the numbers of students has been for some years past on the decrease, having fallen from 1,400 to 800, the object of this vast outlay is difficult to understand.

HOLLAND.

The Polytechnic school of Delft.

(10.) *The Polytechnic School of Delft.*—The Commissioners visited the Delft Polytechnic, the only one in the country having much the character of the schools of the same name in Germany. It is a State institution, under the direction of M. Bosscha, the professor of physics. The Commissioners were accompanied to Delft by Dr. Steyn-Parvé, who introduced them to the director, and with him they were shown over the various class-rooms and collections.* This school, founded in accordance with the law of 1863, was opened in 1864, at which time it contained 91 pupils. It replaced the former academy, which, at that date, contained 259 students, many of whom were transferred to Leyden, to the school established by the Government for the study of the language, geography, and ethnology of the Dutch colonies in the East Indies.

The Polytechnic contains, at the present time, 330 pupils, classified as follows:—

Works managers - - -	7	
Civil engineers - - -	138	
Architects - - - -	3	
Naval engineers - - -	16	
Mechanical do. - - - -	33	
Mining do. - - -	10	
	——	207
Students in training as inspectors of weights and measures - -	5	
Students training for schoolmasters	39	
Attending special courses - -	79	
	——	123
Total - -		330

Special diplomas are given to engineers and architects on the results of the annual examinations. Some few mining engineers are in receipt of scholarships, to enable them to visit German and other mines; and, after having obtained their diplomas, they are appointed, under Government, to the various mining establishments in the Dutch Indies.

Fees.

The payments made by the students are as follows:—

	£	s.	d.	
For the complete course -	16	13	4	per annum.
For each special course—				
Once a week - -	0	16	8	„
Twice a week - -	1	13	4	„
Three times a week -	2	10	0	„
Four times or more -	3	6	8	„

* The Commissioners have learnt with regret of the loss to his country of this distinguished savant, to whose courtesy they were much indebted during their visit to Holland. Those who may desire to obtain information with regard to the educational system of Holland would do well to consult his work entitled "Organisation de "l'Instruction du Royaume des Pays-Bas," Leyden, 1878.

The school is situated in a building erected as a private dwelling-house by one of the directors of the Dutch East India Company, in the early part of the last century, but considerable additions have been made in late years. Since 1873 upwards of 50,000*l.* have been expended on new laboratories for chemistry and physics, drawing schools, and repairs and other improvements. The town of Delft has contributed about 4,623*l.* towards the cost of new buildings.

System of instruction, Delft.

The pupils are free to follow any of the courses they may desire; they are not required to pass any entrance examination, nor is there any examination at the end of the year to gain admission to a higher class. The instruction is based on the degree of knowledge which is acquired in attending a superior intermediate school (higher burgher school) with a five years' course.

The complete engineering course extends over four years, the first two of which are mainly devoted to theoretical studies (mathematics, physics, chemistry, and drawing), and the two latter years to technical studies.

There is also a less extended course adapted to the requirements of works' managers, covering a period of three years.

Diplomas.

In order to obtain the engineer's diploma, it is necessary to pass two examinations, the first of which embraces the theoretical studies of the first two years, and the second the technical work of the last two years of the course. No one is permitted to go up for the latter examination who has not obtained the certificate of the first of these examinations, and, in order to obtain the former certificate, it is necessary to present a leaving certificate of examination from an intermediate school, with a five years' course.

The diploma given to works' managers is awarded on the result of a similar examination at the termination of that course. The examining body, on which the teaching staff of the school is largely represented, is nominated every year by the Minister of the Interior. There have been 635 diplomas of engineering granted since the establishment of the school.

Students have free access to the laboratories and to the school library.

Budget.

The budget of the school is as follows:—

	£
Payment of professors, staff, &c. - -	8,758
Maintenance of buildings, collections, heating, lighting, &c. - - -	2,683
Total - -	11,441
Deduct receipts from students, &c.	3,916
Annual cost to the State -	£7,525

Staff.

The staff comprises a director, who is also one of the 12 professors, 8 occasional professors, and 6 assistant professors. The

director's salary is 333*l.* per annum and a house; the professors are paid 300*l.* a year; and the assistant professors receive from 67*l.* to 167*l.* a year.

The details of the courses of instruction, which are very similar to those of the German schools, will be found in the Appendix.

It would appear that, in consequence of the severity of the examination for the diploma, a very considerable number of students are annually rejected. The average age of the students on entrance is 18 to 19 years.

Physical laboratory.

The school possesses an excellent library, as also a good physical collection, and a room containing apparatus, used as a species of physical laboratory for training Government inspectors of weights and measures. The physical lecture-room is modern, and well fitted up. In connection with it is a gas-engine and a small dynamo-machine; also a laboratory and workshop for repair of physical apparatus. There was a special room for delicate experiments. Among the apparatus noted was a balance to weigh 25 kilos., with an error of 2 milligrammes; Airy's gas-verification apparatus; and a collection of telegraphic clocks. Experiments were in progress for the verification of the Ohm.

Architectural school.

There is a large architectural lecture theatre and drawing room; a room for advanced architecture, in which students make original designs for large and important buildings. The collection of models of building construction is very complete. There is also a collection of building materials, as well as drawing rooms for ornament, the antique, &c.

Chemical laboratory.

In the well arranged chemical laboratory of Prof. Oudemans there were about 30 students. The laboratory, erected at a cost of 5,000*l.*, consists of a large central top-lighted hall, round which are grouped the various departments, balance rooms, combustion room, engine room, lecture theatres, &c. There is also a large laboratory for practical chemical work for engineer students, capable of containing 60 to 70. We were informed that this was the only laboratory in Europe with steam power vacuum and blast laid on to all parts of the establishment. There is a good collection of chemical preparations. All the departments communicate with a lofty central chimney by means of flues in which the draught was stated to be 20 feet per second. The ventilation is on the plan of General Morin.

Museum.

The Commissioners were conducted through the Museum of Mechanical Technology on the first floor, which contains collections of raw and manufactured products,—pottery, wool, paper, cotton, linen, metals,—and some models of machinery.

Engineering Department.

On this floor are the three drawing rooms for engineers, and collections of models of parts of machines, joints, couplings, &c., mostly made in the institution. There are about 30 students in the department of mechanical engineering, but accommodation has been provided for a much larger number.

All the rooms seemed large for the number of students present. There is a collection of minerals, &c., for the mining engineers, and a small metallurgical laboratory adjoins their class-room. The department of civil engineering contains nearly 150 students, and is the largest in the school. The State provides the means of obtaining a year's experience of practical work. Technologists generally spend four years, from the age of 18 to 23 at this school, and have one year at practical work before entering it. On the principal building an observatory has been erected, in which astronomical observations are made. The numerous class-rooms and drawing rooms for engineers, architects, and naval students were inspected. There is also a large collection of casts from the antique, from which copies are supplied by the school to other institutions.

School of industrial art.

There is a completely fitted art school, and a special feature of this Polytechnic is the attention paid to the study of practical decoration; porcelain, furniture, wall paper, and other designing being taught. Students also learn designing for textile manufactures.

Workshops.

In the workshops for making models, some 20 of the students engage in practical manual work; this, too, we did not find in any school of this kind elsewhere. These students belong chiefly to the department of mechanical engineering. There is a modelling room for copying from ornament and the antique. The director informed us that many students travel backwards and forwards each day to the school from the Hague, Rotterdam, and Schiedam. The Commissioners were much impressed with the practical yet unostentatious character of this institution, which appears to be doing excellent work.

RUSSIA.

Imperial Technical School at Moscow.

(11.) *The Imperial Technical School of Moscow.*—This school, though it was not visited by the Commissioners, may be briefly noticed in this division, as it occupies a rank somewhat distinct from any of the other institutions in this group. Its aim is to give a very high-class engineering education, in which the theoretical studies are largely supplemented by practical work in the shops; in order, moreover, to give to this practical work the due amount of thoroughness, and to avoid the error of want of appreciation of the value of time as an element in mechanical work, large contracts for actual work for private individuals are taken by the school, which are carried out partly by hired labour and partly by the co-operation of the students. The theoretical training is said to be of a very high order, most nearly resembling that of the École Centrale of Paris.

Entrance.

Admission to the school can be obtained, either on passing a qualifying examination, or on presentation of the leaving certificate of a Gymnasium or Real school, but there is a preparatory division to which students are admitted who have not fully completed their secondary education. All the students wear a semi-military

costume, and those who have obtained the full diploma are provided with posts under Government. The fees are, for boarders 45*l.* per annum, day boarders 15*l.*, and foreign auditors 11*l.* per annum; the annual receipts, including interest on the endowment fund, are about 32,000*l.* and the expenses are 28,000*l.*, leaving an annual sur plus of 4,000*l.** The staff of professors, tutors, and practical instructors is very extensive, and the school possesses a fine library and collections of apparatus, models, and natural history specimens. Fees.

There are two divisions in the school, one general and the other special: the latter division is sub-divided into three branches,—for mechanical construction, mechanical engineering, and engineering technology respectively; each division has a three years' course, and the full course extends over six years. In the general division the subjects taught are as follows :— Divisions.

Algebra, practical geometry, differential and integral calculus, mechanics, machine drawing, free-hand and linear drawing, descriptive geometry, physics, zoology, botany, mineralogy, chemistry, geodesy, French, German, and Religion.

In the special division the subjects of instruction are inorganic and analytical chemistry, metallurgy, applied physics, mechanical and chemical technology, properties of wood and metals, practical mechanics, railway construction, engineering, the art of constructing, designing, and estimating machinery and mill-work, factory design, industrial statistics, and book-keeping. All students spend some hours daily in the shops. Workshops.

The practical department is in two divisions, namely, the workshops, in which actual contract works are executed, and the practising shops, under the charge of specially trained foremen, where the students learn filing, turning, pattern-making, joiners' work, smiths' work, and moulding. The works are on a sufficiently large scale ; they consist of joiners' shop, engineering shop, painters' shop, an erecting shop, an iron foundry, a brass foundry, and a smithy. These works have one engine of 30, and another of 10 horse-power. There is a regular drawing office and counting-house attached to them, and remunerative work is said to be carried on to the extent of from 8,000*l.* to 10,000*l.* per annum. The instruction in the practising workshops is compulsory, and all the students must go through the course, before they can be admitted to the manufacturing shops. The result of this sub-division is stated to have produced very satisfactory effects. A collection of models has been formed, and a regular course of work in three stages, each lasting 240 hours, has been devised for each trade. The staff consists of a director, M. Della-Vos, and 45 professors, masters, and tutors, 11 engineers, assistants and foremen, 15 assistants, &c., 84 non-commissioned officers and soldiers, and 100 workmen in the various shops. There are 100 free students (boarders), 200 paying boarders, and 282 day students. Staff.

* The school capital is valued at 496,000*l.*

Professor Fuller, of the Worcester Free Institute of Industrial Science, Massachusetts, who has visited the Moscow schools, has informed the Commission that owing to the want of sufficient preliminary training, a large number of students do not rise beyond the position of superior workmen or foremen, and are not capable of receiving an education of a higher grade than that given in the Écoles des Arts et Métiers of France. Nor do we hear a very satisfactory account of the value of the instruction as measured by the number of competent men leaving the school.

The Royal Saxon Mining School of Freiberg.

The Mining School of Freiberg in Saxony.—Of the numerous mining schools of Europe probably the Royal Saxon "Berg-akademie" of Freiberg has trained the largest number of successful miners and metallurgists, and the title of M.E. (mining engineer) of that school is a guarantee of excellence, and serves as a recommendation of the greatest value. The reason of this is obvious when we know that the system of instruction carried on here is a thoroughly practical one, so that the students are brought into actual contact with the operations on a large scale.

The object of this time honoured institution is to give a complete scientific education both of a theoretical and practical character to young men intended for metallurgists or mining engineers.

Admission.

Admission to the school for Saxons and Germans, is made dependent on having passed the Maturitäts examination of a Gymnasium or first class Real school, but foreigners are received without examination, provided they bring certificates of competence from some recognised scientific or educational institution, and this liberality on the part of the Saxon Government has been largely availed of by many distinguished English and American metallurgists and mining engineers.

Regular courses of study are laid down extending over four years and differing according as the pupil desires to follow the mining or the metallurgical branch of the profession. Higher mathematics, descriptive geometry, spherical trigonometry, physics, chemistry, mineralogy, geology, and mechanical drawing, form the groundwork of the studies, to which are added, in the second and succeeding years, the special subjects of mining and metallurgy and all their allied branches of science, taught by lectures, laboratory practice, by working and surveying in the mines, and by practical metallurgical instruction in the smelting works of the Saxon State.

The collections of mineralogical and geological specimens are most complete, and with the libraries and museums of mining machinery, are open to all the students of the school. Many of the professors have been men of European fame—Werner,

Plattner, and now Richter and Weisbach, are names known to and honoured by all students of science. The lectures of Richter on the blow-pipe are unique, and those of Professor Weisbach on mineralogy are most valuable. But the most important respects in which Freiberg excels, is the practical experience which the students can gain in the operations of smelting conducted on a large scale in the Government smelting works (the Müldnerhütte and that at Halsbrücke) as well as in those of mining by visiting the neighbouring mines belonging to the Saxon Government. As these mines now yield ore of only the poorest quality, the operations have to be conducted with great care, and hence offer, to the student of mining, training of an exceptional character, while the number of metals present in the ore (gold, silver, copper, lead, bismuth, arsenic, and antimony) and worked up at the smelting works, afford a no less valuable one to the student in many branches of metallurgy.

The cost of living in Freiberg, including the fees payable to the academy, need not exceed 100*l.* per annum. The average number of students in training for the last 10 years is: Saxons and Germans, 64; foreigners, 58.

The Leoben School for iron-smelters.

Freiberg does not, however, afford practical instruction in iron mining or smelting; the mining school specially adapted for the study of the metallurgy of iron is that of Leoben in Styria, under its veteran head, Professor von Tunner.

General Review of Polytechnic Schools.

Opinions on the training for, and the value of, polytechnics.

Having concluded our report on the Polytechnic schools of Germany, we pass to certain important general considerations respecting the higher scientific and technical education in that country. In the first place, the question as to the value of the training at the Polytechnic school, as compared with that given at the University, and especially as to how far the division into purely scientific subjects as taught in the Universities, and applied science as taught in the Polytechnic schools of Germany, is a wise or advisable arrangement, as also of what is the best preliminary training for polytechnic students, has been the subject of much discussion, and the Commissioners have been at the pains of obtaining opinions on this subject from a number of distinguished men connected with the Universities and also with the Polytechnics.

It may be mentioned that in the Polytechnics of Germany there is accommodation for about 6,000 students, whilst the total attendance is little more than 2,000, and the annual cost to the State of each student, exclusive of interest on capital, is about 100*l.* This apparently unnecessary extension of the Polytechnic schools in that country is partially accounted for by the fact that, when they were originally erected, Germany consisted of several independent states which have since been united in the German empire.

Professor von Helmholtz on German Polytechnics.

In support of this conclusion, Professor von Helmholtz stated to the Commissioners that whilst he set great value on the highest technical instruction, as given in Germany, in aiding the industrial manufacturers of the country, he considered that the number of Polytechnics or Technical Universities in Germany was in excess of the present requirements of the people, and had come to be so in consequence of the altered political condition of the country, which no longer consisted of separate states endeavouring to rival one another in the extent and excellence of their educational institutions.

Dr. Werner Siemens.

This opinion was further corroborated by Dr. Werner Siemens, who went so far as to say that the new and splendid edifice, now being erected at Charlottenburg, near Berlin, for the purposes of a Technical University, would be sufficient for the whole of North Germany.

Professor von Helmholtz on the value of scientific knowledge.

Professor von Helmholtz pointed out to the Commissioners not only the general advantages, but also the absolute economy, of employing persons as heads of departments, conversant with the theory of their work, and able by virtue of their scientific knowledge to anticipate results, and to calculate beforehand the quantity and quality of material required, as compared with those who, failing this knowledge, are compelled to adopt, often at greatly increased cost, the more empirical method of repeated trial. He further stated that his son, owing mainly to his knowledge of physics, especially of the mechanical theory of heat, had risen to a post of considerable importance in the locomotive works of Herr Krauss, at Munich, in which he had been placed.

Chemical instruction in Polytechnics and Universities.

As regards the chemical instruction given in the Polytechnics and Universities of Germany, the opinion was very generally expressed at Berlin that there is no essential distinction between the methods and the results of the teaching of these two classes of educational institutions. Indeed, it may be fairly assumed, in spite of some opinions to the contrary, that in the teaching of chemistry the aims and objects of the Polytechnic overlap those of the University; the advantage of Polytechnic instruction for those who are to occupy the higher posts of managers in chemical manufactories, consisting in the opportunities afforded to the students of obtaining the necessary additional instruction in machine construction and drawing.

As giving some idea of the number of students who in Germany are receiving practical chemical instruction of a high order, Professor Liebermann, Director of the Chemical Department of the Technical High School, stated that the total number of students working in the laboratories of Berlin alone, amounted to close upon 400. And we learn that during the present winter (1883–4), no less than 50 students are engaged in original organic research in the laboratory of the University of Munich, under Professor Baeyer.

Dr. Martius, a large chemical manufacturer of Berlin, spoke very strongly concerning the great progress made in manufactures in Germany during the last 10 years, particularly in the chemical branches. He himself employs 14 trained chemists, each of whom has charge of a department, and they supervise operations with a care and attention which an ordinary foreman, not equally well trained, is unable to give. Dr. Martius considered that whilst the English foreman is in many respects superior to the German foreman, Germans possessed a distinct advantage, in chemical industries, over the English, in the number of highly trained scientific men in Germany who are always available as foremen or superintendents of departments of the works. As regards foremen in other trades, and workmen in general, he did not consider that the technical education of these classes in Germany was superior to that of the same classes in England; and it is with the view of improving the technical education of foremen and of superior workmen that *Werkmeisterschulen* or foremen's schools are now being instituted in Germany.

Dr. Martius on influence of chemical training in Germany.

Dr. Werner Siemens inclined to the opinion that the best foremen and managers of works were those who having had a good general education, had been employed for some time in practical work in the shop, and had afterwards spent two or three semesters in a *Werkmeisterschule*, with a view of supplementing their practical experience by theoretical instruction in the scientific principles applicable to their trade. He thought it advisable that of those receiving this kind of training, the ablest and most highly gifted pupils should pass on to the higher technical schools. Dr. Siemens added, that he himself was in the habit in some cases of selecting young men of promise and of paying their expenses and maintenance at the *Werkmeisterschule*, and, in others, of giving them the opportunity of dividing the year between work and school, so as to enable them to pay for themselves. He had established in his own works a complete physical laboratory in which tests of the greatest delicacy were continually being carried on. Dr. Fröhlich, a distinguished physicist, was his associate in the business, and superintended this scientific laboratory.

Dr. Siemens on training of foremen, &c.

With respect to the best preparatory training for polytechnic instruction, various opinions were expressed. Professor Hofmann is in favour of the Gymnasium training, preferring it to that of the first grade Real School, notwithstanding the fact that in the latter the pupils obtain fairly good instruction in natural science, and scarcely any in the former. But he was bound to admit that this superiority on the part of the Gymnasium students may be due, in part to the fact that the pupils are drawn from a class which for several generations has received superior culture, and also to some extent to the methods of classical tuition being more matured than those of science, so far as secondary education is concerned.

Professor Hofmann on preliminary training for polytechnic instruction.

Mr. Glaser on influence of polytechnic instruction.

Herr Glaser, patent agent, and agent for the Bochum Stahl Verein, furnished the Commissioners with one or two special examples of the improvements in machinery, &c., which had officially come under his notice, and which were in his opinion to a great extent the result of the training which the students received in the Polytechnic. He did not consider, however, that, till recently, invention had had fair play in Germany, owing to the defective nature of the old patent law.

Dr. Victor Meyer.

As regards the question of Polytechnic as against University training, Dr. Victor Meyer, the Professor of Chemistry at the Zurich Polytechnic, expresses it as his opinion that so far as technical chemists are concerned the education would be equally well given in a University were a technical faculty founded in addition to the faculties existing for the purely theoretical sciences. He also supports Professor Hofmann in the view that the Gymnasium training serves equally as well for the subsequent studies of the Polytechnic as the instruction of the Real School. So far as his subject is concerned, he does not recognise any essential difference in the nature of the studies of the Polytechnic on the one hand, and of the University on the other,—indeed the University students of medicine are technical students who study applied science. Professor Meyer thinks that the end to be desired is as complete an amalgamation as possible of the studies of the University and the Polytechnic.

Professor Fick.

Dr. Fick, Professor of Physiology at the University of Wurzburg, formerly a professor in the Zurich Polytechnic, also supports the view that the union of the University with the Polytechnic school would be distinctly advisable. He thinks that by this means much economy in tuition, as also in its cost, might be effected. He believes that the introduction into the Universities of the subject of engineering would be a distinct gain to these institutions, and points out the advantages enjoyed by the University of Zurich from its proximity to the flourishing Polytechnic.

Professor Kühne.

The above opinions are also shared by Professor Kühne of Heidelberg.

Professor Lunge.

Professor Lunge of Zurich, who was for many years resident in England, where he was the manager of a large alkali works, holds, with regard to the preparatory training of technologists, an opposite view to that of Professor Hofmann which has been already referred to; and Professor Lunge's views are shared by an equally eminent authority, Dr. Wislicenus, Professor of Chemistry at the University of Wurzburg. Dr. Lunge holds that the linguistic training of the German Gymnasium is unsuited as preparatory to a technical career, inasmuch as the time there devoted to mathematics, drawing, and modern languages, as well as to the elements of natural science, is wholly insufficient, and he therefore inclines to the opinion that the education given in the Prussian Realschulen of the first rank, corresponding to the Bavarian Real-gymnasium, is distinctly

preferable to the purely linguistic system of education of the Gymnasium proper. With respect to the union of the Polytechnic with the University, he alludes to the difficulties which would arise from the fusion of these teaching bodies in the case of the large towns and the capitals of Europe, on account of the inordinate dimensions these institutions would assume. He thinks that in smaller institutions such a fusion or partial union would be productive of excellent results, and he also draws attention to the value of the addition of an engineering faculty to the smaller Universities. He points out the great economy which arises from having the two institutions in the same town, as at Zurich, and the great saving of teaching power of which this arrangement is productive.

Dr. Quincke.

Dr. Quincke, who has been Professor of Physics at the Berlin Polytechnic School, and who now is Professor of Physics at the University of Heidelberg, whilst agreeing in the main with the foregoing opinions, points out the error made by many in believing that any Polytechnic course of teaching can by itself teach a student to erect an engine, work a blast-furnace, or manufacture sulphuric acid, the real object of the technical school being to facilitate the transition from pure science to practice by means of appropriate lectures and laboratory work, which are obviously insufficient to prepare the student for carrying on actual work where practical experience is needed. He likewise points out that the number of scientifically trained men sent out from the Polytechnic Schools of Germany, has been in excess of the number of the existing high class industrial positions open to them, so that Polytechnic students have been compelled to take subordinate positions.

As regards preliminary training, Professor Quincke shares Professor Hofmann's views as to the superiority of the Gymnasium for this purpose over the Real School. He thinks, moreover, that the addition of technical faculties to the Universities would not only bring valuable teaching power into these institutions, but that the existing subjects of mathematics and natural science would thus be brought nearer to the actual requirements of the day, so that the "Universitas Literarum" would become adapted to the age of railways, steam engines, and telegraphs; as centuries ago, the needs of Church and State added a fourth faculty, that of "Philosophy," to the existing faculties of theology, jurisprudence, and medicine.

Polytechnic and University teaching compared.

Conflicting as these opinions may seem to be, the Commissioners cannot help calling attention to the fact that in every country visited, separate institutions have been established for the teaching of the higher branches of science, according as the object has been merely the advancement of knowledge for its own sake, or its applications to industrial operations. Thus institutions more or less similar to the Polytechnics of Germany, exist in Switzerland, in Holland, in France (in the École Centrale), in Italy, and

in Russia; and similar institutions have been very recently founded in America. Moreover, even now, there is still incomplete and in process of erection by the German Government, on the one hand the magnificent Technical High School of Berlin, and on the other the University of Strasburg, by far the grandest and most elaborately fitted of all the German Universities; in which, latter however, no provision is made for the faculty of engineering, and where the instruction in mathematics and science will be maintained on the same high level as in other Universities, and will be in no way fettered by the necessity of keeping in view the requirements of students in their future career, or by the commercial aspect of the problems under consideration.

Chemistry.

Where the instruction of the University and Polytechnic seems most to overlap, is undoubtedly in the teaching of chemistry. Although it has been admitted that for the training of an industrial chemist a knowledge of drawing and of machine construction is almost indispensable; on the other hand—as regards the remarkable discoveries which have been made by German chemists who have devoted themselves to research work in the highest branches of the science, and which have had so great a commercial value and have pushed forward to so great an extent the chemical industries of Germany—the Universities equally with the Polytechnics have been the cradle in which technical chemists have been reared; and the professor, whether at the University or at the Polytechnic, who has established the greatest reputation by virtue of his successful investigations into the highest branches of chemistry, has attracted to his classes the largest number of students. The really all-important factor in the training of an industrial chemist is the time he can devote to the study of this science; Professor Baeyer of Munich stated that a course of seven years' instruction was needed to make a first-class chemist, and this can, of course, be obtained under a competent teacher either at the University or at the Polytechnic. In the case, however, of a student who does not aim at so high a standard of proficiency; who requires, as speedily as possible, to obtain an insight into the practical details of the work in which he is to be engaged, a course of instruction which includes lessons on the technology of his trade, and research work directed towards the same end, is undoubtedly serviceable. In either case instruction in machine drawing and construction should be regarded as an essential part of the course of training of an industrial chemist who is not to become a mere analyst. Examples are not wanting of chemical industries being founded, superintended, and carried on in this country by Germans who have received their education in the Polytechnics or Universities abroad, but who find in our own country the necessary capital and labour, the raw material, and the industrial facilities, which enable them to turn to commercial purposes their own scientific knowledge.

Mathematics.

But this fact must not cause us to lose sight of the difference in method in the teaching of other branches of science, when

taught independently of, or as ancillary to, their commercial applications. In mathematics, for example, the highest university teaching, which is of the utmost value to every person studying the subject for its own sake, or with the view of teaching it to others, is not equally necessary for persons who learn mathematics that it may be an instrument in their hands for the solution of ordinary engineering problems. And equally in physics, in one branch of which at least the commercial aspect of the science is coming to the front, the investigations which would be carried on in a research laboratory, under the direction of a professor not necessarily interested in electrical problems, for example, the solution of which at present have a distinctly economic value, would not prove as useful or as attractive to a student, as investigations more immediately connected with the industry in which he is to be engaged, and towards which he feels that his studies ought to be directed.

At the same time it is clear that in physics, equally as in chemistry, the knowledge of the principles of the science and of the methods of research is the more important part of the theoretical equipment of the technical student, and provided the laboratories possess the necessary apparatus, this instruction can equally well be given in an institution devoted to the teaching of pure as of applied science.

Engineering.

Amongst the various reasons for confining the teaching of engineering to the Technical Universities, (the Polytechnic Schools), instead of establishing a separate department in the Universities proper, for engineers of all kinds, as is done for medical students, the Germans and other nations have probably considered that the presence of large numbers of persons studying science, not so much for the mere advancement of knowledge, as for the sake of its industrial and commercial application, might have the tendency to lower in some cases the character, and in other cases to change the stand-point, of science-instruction; and although the combination of University and Polytechnic in one building might have involved a considerable saving in teaching power, this economy would have been dearly purchased, if it had led to any diminution of the zeal with which purely theoretical studies and scientific investigations are pursued at the Universities.

Influence of competition.

Moreover, it must be admitted that the healthy competition that has taken place between the faculties that are common to both the University and the Polytechnic, has not been without effect in raising the character of the instruction in both these classes of institutions, in introducing, especially in the teaching of science, a sound practical method into the University, and in preventing the Polytechnic from becoming too exclusively a school of application, to the neglect of that instruction in principles which is properly recognised as being indispensable to the success of every student.

General diffusion of scientific education and its results.

To the multiplication of these Polytechnics and to the small cost of a higher or University education, may be ascribed the general diffusion of a high scientific knowledge in Germany, its appreciation by all classes of persons, and the adequate supply of men competent, so far as theory is concerned, to take the place of managers and superintendents of industrial works, as well as of teachers in technical and other schools.

Need of similar schools in England.

In England, there is still a great want of this last class of persons; and whether schools of practical and applied science be affiliated to the University, or exist separately and independently as in other countries, it is very important that facilities should be offered to such selected pupils from schools of lower grade as may be competent to profit by it, to receive the highest scientific and technical instruction, gratuitously, or at a small cost, in order that this country may be better supplied than it is at present with competent instructors.

As regards the kind of training that will best fit a youth to become the head of an industrial concern, opinions both here and abroad differ considerably; but in the value of the education given in the German Polytechnics as a part of the training of engineers, most competent authorities on the Continent appear to agree.

Education of industrial proprietors at Gymnasia and Universities.

In dealing with the superior education of those destined to become employers or proprietors of large industrial concerns in Germany and Switzerland, we must state in conclusion that the Gymnasia and Universities in spite of the existence of the numerous Technical High Schools, still serve to train probably the larger portion of those who are to take the lead in manufacturing industries, and that, consequently, the persons so educated cannot be said to receive any technical training in the school. The University is the natural termination of the career of the student entering the Gymnasium, which is *par excellence* the school of the higher and the upper middle ranks of society on the Continent; and, where time and money are of secondary importance, no education is deemed to have been properly completed without a few years passed at one or other of the numerous Universities.

Large number of Continental Universities.

There are in all four and twenty Universities in the German Empire, five in Switzerland, nine in Austria, and the German University of Dorpat in Russia, and the total number of students who are being trained in them is little short of 35,000. In the first rank, as regards the number of those under instruction, stands the University of Berlin with the enormous total of 4,995 students, together with 3,900 non-matriculated auditors. Leipsic comes second, with a total of 3,166 students, and 3,111 auditors, while Munich has respectively 2,049 students, and 2,017 auditors In the next class are the important and flourishing Universities of Breslau 1,682 students, Halle 1,414 students, Tübingen 1,414, Bonn 1,102, Göttingen 1,096, and Würzburg 1,091, while the

Russian University of Dorpat numbers 1,277 students, and the Austrian University of Lemberg is returned at 1,011. The numbers at Vienna and Pesth are not stated, but they probably considerably exceed those at Lemberg. The staff of professors for this immense body of students is equally remarkable. Thus at Vienna, there are in all 272 on the teaching body, including however 127 honorary academical professors. At Berlin, the total teaching staff numbers 241, at Leipsic 171, Prague 150, Pesth 143, Munich 141, Breslau 123, Göttingen 119, Bonn 110, and Heidelberg 109.

Cost of the new German University, Strasburg.

To give an idea of the large sums spent by the German Governments on the scientific departments of their State Universities, it may suffice to mention the cost of a few of the departments of the new University of Strasburg. The total outlay on the buildings of this University, either now complete, in process of erection, or planned, is 600,000*l.* The department of botany has had a sum of 20,000*l.* devoted to it; that of physics 30,000*l.*; that of chemistry, including a residence for the director, 35,000*l.* These items include the permanent fittings of the various laboratories, but not the apparatus and collections which have been partly inherited from former years, and are partly purchased from the annual allowances of the various departments.

Chemical Department. Budget.

The yearly budget of the chemical department amounts to 1,335*l.*, not including either the salaries of the two professors (about 800*l.*) or the cost of heating and lighting, which are defrayed by the University. It includes the salaries of five assistants (255*l.*) and the wages of four servants (260*l.*), leaving a sum of 820*l.* to meet the general working expenses of the department, including the purchase of chemicals, apparatus, specimens, &c. The number of students working in the chemical laboratories at Strasburg is about 100.

Swiss Universities.

The *Swiss Universities*, which closely resemble those of Germany in their constitution, and in the scope of their curricula, though on a somewhat smaller scale, are, as we have stated, five in number, and exist at Berne, Zurich, Basle, Geneva, and Lausaune. A remarkable institution visited by the Commissioners is the *Bernoullianum of Basle*, which contains the chemical, physical, and astronomical departments of the University of Basle. It was erected by public subscription, as a memorial of Bernoulli, the celebrated mathematician, at a cost of 18,000*l.* Bernoulli was a native of the town, and a professor at the University. The institution comprises laboratories, class-rooms, and a completely fitted astronomical observatory. In a large lecture theatre attached to the building, courses of popular lectures are delivered by the professors and other eminent men, who give their services gratuitously. We were conducted through the premises by Professor Hagenbach-Bischoff, who explained to us the mode of illustrating the lectures by a magic-lantern connected with the electric light apparatus, the fittings for which have

The Bernoullianum of Basle.

been introduced at a cost of 450*l.* There are, for this purpose, a gas-engine, dynamo-machine, and lamps; the cost of this installation was defrayed by public subscription. The lectures are largely attended.

The observatory contains a fine 7-inch equatorial, and the usual recording instruments.

The physical laboratory and lecture theatre are especially well fitted, having water at a pressure of 4½ atmospheres, and an arrangement for graduated pressures by tanks suspended at various heights from the floor. The lecture-table is elaborately arranged with electrical appliances. There is a fair collection of apparatus, some of which is of historical interest, in a museum at the rear of the institution. A catalogue of a portion of the collection in the handwriting of Bernoulli was shown to us.

The chemical department is extensive and well fitted. The professor, M. Piccard, gave us an interesting disquisition on the subject of Polytechnic as against University training; his views coinciding with those of Dr. Fisk, already quoted.

Education of Industrial Teachers.

Paris.

École Normale Supérieure de Travail Manuel.

The *École Normale Supérieure de Travail Manuel*, 10, Rue des Ursulines, Paris, has been created for the training of masters, who shall instruct the students of the ordinary normal schools of the country in manual work. It was established and opened on the 1st December 1882. The course, as at present arranged, lasts for one year of 10 months. It is, however, contemplated that it will be necessary to extend it over a second year eventually, but as the masters are very urgently required, it is necessary to prepare a certain number in the one year for the present.

Entrance examination.

The students have to pass a qualifying entrance examination, which consists of the Brevet de Capacité, usually required for teachers, and certain extra subjects—chemistry, physics, and natural history; they do not require to be qualified in any way in manual work before their admission. The limit of age is from 20 to 35. Although the Brevet de Capacité will eventually be indispensable, the regulations have in this first year been somewhat relaxed.

School buildings.

The school is held in a former girls' school, which has been hastily and temporarily fitted up for its present purpose. It has a considerable area of land at back and front. There are two small botanical gardens, and a gravelled court-yard serving for recreation and gymnastic exercises. It is intended that the students shall have military training.

Number of students.

There are at present 48 masters in training; this being the full capacity of the establishment. Thirty of these board in the house, and the remainder are provided for in the neighbourhood.

The cost of fitting up the school has been about 2,400*l*. The instruction is gratuitous. In fact, the students receive payment, as those who are already teachers of primary schools retain their pay while they remain here, and the others receive the sum of 5*l*. per month. There are seven professors forming the teaching staff, and ten master workmen. The latter are only employed during certain hours, giving such a portion of their time as may be needed. All the work done in the workshops belongs to the students; nothing made is intended for sale. The cost of materials used in the workshops is about 7*l*. 4*s*. per month. It is expected that the budget of the school will amount to 3,600*l*. for the first year of 10 months, equal to about 7*l*. 10*s*. per head per month. All the costs of this school are borne by the State, but as it is an experiment only, there is no sum yet taken for it in the budget estimates. Cost of fittings workshops, budget, &c.

It will be seen from the programme in Appendix 22, that the course of instruction is partly theoretical and partly practical. One-and-a-half hours per day are allotted to theoretical work, and 4½ hours to mechanical work in the shops. There is no practising school attached to this normal school, as is generally the case, but demonstrations are given by each student in turn before the others, in presence of the master. The teaching is uniform, all going through the same stages. Programme.

The mornings are as a rule devoted to working in wood, the afternoons to working in iron. Each student makes a set of small models for his own use for teaching purposes. Model-making seems to be a strong feature of the teaching. There is a special modelling room, in which all are taught modelling in clay and subsequently the preparation of plaster models of building construction on a small scale,—masonry joints, stone-work, &c.; there is a special teacher for this branch of work, and four hours per week are devoted to it. We were shown some very neat plaster models of arches, made to a scale of $\frac{1}{10}$ full size, careful drawings of which had first been prepared. Course of instruction.

The fitting shop contains 24 vices. All the students learn to file and to chip. There is a regular set course of work lasting four months. Places are provided in the smithy for six students, who learn forging and welding, making up bars from faggots of scraps, making nuts and bolts, &c. Six work simultaneously at the iron lathes in the turning shop, and 12 at the wood lathes. There are two foreman-workmen in each of the shops, with the exception of the turnery, where there are three. The students pass two months at wood turning and two months at iron turning. There is no power provided for the lathes, as none could be obtained in the schools to which the teachers would eventually be sent. Workshops.

The natural history teaching is also made a special and prominent feature in this school. There are two professors in this department The professor of botany gives lectures in his subject, Instruction in natural history

illustrated partly by the specimens in the botanical garden, and partly by the excursions, which take place every fortnight. There is also a physiological laboratory, which contains a large collection of aquaria, together with toads, and tortoises in tanks: also many other living animals, rabbits, rats, squirrels, &c. These are not used for purposes of vivisection, but for simple anatomical lectures, for stuffing, &c.

Photographic laboratory.

There is a well-fitted laboratory, in which all the students learn photography. They are specially taught how to prepare negatives suitable for screen projection, as this is regarded as an important mode of illustrating lectures on natural history.

A geological collection is being formed by the students, who go out on an excursion in the neighbourhood of Paris once every fortnight on a weekday during the summer, and also on Sunday afternoons.

Collections, apparatus, &c.

On the upper floor of the school is a series of rooms, where the students prepare their studies. Here we were shown a small collection of woodwork, made in the Swedish Slögd schools, and collected and presented by the director, M. Salicis. In another room were hung numerous satchels and tin botanizing boxes, butterfly nets, geological hammers, &c. for the excursions previously described. This apparatus was all numbered, and is lent to each student during the time he remains at the school. Here was also a collection of diagrams of simple dissections used by the professor of physiology.

School museum chemical laboratory.

On the first floor was a school museum and lecture theatre; on the ground floor a refectory, where the students and masters take their meals together. There is a very cleverly fitted chemical laboratory; the professor being the former chemistry master at the Professional School of Rheims. This laboratory, which occupies an area of only 550 square feet, contains working places for 48 students. The benches are covered with white glazed tiles, and provide a metre in length for each student. The sets of reagent bottles had india-rubber stoppers with pipettes passing through them, thus enabling the student to use at will either a very small or a larger quantity of the reagent. The professor explained his system of chemical work to be one of regular drill, all the students performing a series of set experiments simultaneously; he having a raised desk, from which he could overlook the whole of the work in progress, and see that each man was carrying out his experiment properly.

Master workmen will be trained at other schools.

The sub-director, M. Merceaux, informed us that it was not proposed, so far as he knew, to establish schools for training master-workmen to serve as instructors in primary schools; such men could, doubtless, be readily obtained from the Arts and Trades Schools at Aix, Angers, and Châlons. Several of the masters at this school have come from the École des Arts et Métiers at Angers.

The students, whether living in the house or lodging in the neighbourhood, are all free after 6 o'clock. No masters have as yet issued from the school, as a full year has not yet expired since its establishment, but M. Merceaux stated that he thought that some of the men then in training would be perfectly competent to undertake the duties for which they were being prepared at the expiration of the pre-arranged course. He stated that there was considerable inducement to masters to exchange a career of teacher in a primary school for that for which they were here trained, as the salary of a professor at a normal school was approximately double that of an ordinary primary school teacher.

Work is over at 6 o'clock in the evening.

Influence upon Industry of Institutions for Scientific Research.

École Pratique des Hautes Études of France.

In order to indicate the value placed in France upon original scientific research, we may mention the École Pratique des Hautes Etudes of France. This institution deserves a special notice on account of the opportunities it affords for practical investigations which have in some instances excited a direct influence on the commercial and manufacturing interests of the country. It consists of a collection of laboratories, in which original scientific research is encouraged and carried out. Founded under the ministry of M. Duruy in 1868, it has been the means of furthering most important investigations, both of a purely scientific nature as well of a practical character, and in proof of this, it is only necessary to say that the whole of Pasteur's work, to which reference is made in the sequel, has been accomplished by the aid of this institution.

The object of this school, or rather collection of schools, is stated to be "de placer à coté de l'enseignement théorique les "exercices qui peuvent le fortifier et l'etendre." The institution is divided into four sections—

1. Mathematics.
2. Physics and chemistry.
3. Natural history and physiology.
4. Historical and philological science.

The most eminent men in France are chosen as the directors of these schools. Students are admitted gratuitously, and there is no restriction either as to age or to nationality, but candidates must convince the director of their ability to profit by the instruction, and of their fitness to conduct research.

The laboratories are attached to several of the higher educational institutions, such as the Sorbonne, the Collége de France, the Museum of Natural History, &c., and they are of two kinds (1) teaching laboratories, (2) research laboratories. The establishment of private laboratories for these purposes is also permitted. The expenses of these laboratories are defrayed by

the ministry of public instruction, an annual grant of 12,000*l.* being made for this purpose, besides which the municipality of Paris votes the annual sum of 960*l.* for exhibitions, travelling fellowships, and prizes of books or instruments.

A commission of five persons named by the minister from amongst the directors of the laboratories, is appointed for the purpose of arranging the studies of the pupils.

The following serves to show the nature of the subjects and the institutions in which the teaching is conducted :—

1. Mathematics. Committee of studies, MM. Chasles, Hermite, &c.
2. Physics and chemistry. Committee, M.M. Berthelot, Jamin, Wurtz, &c.
   - (*a.*) Laboratory for physical research in the Natural History Museum.
     Director, M. Becquerel.
   - (*b.*) Laboratory for teaching physics at the Sorbonne.
     Director, M. Desains.
   - (*c.*) Laboratory for physical research at the Sorbonne.
     Director, M. Jamin.
   - (*d.*) Laboratory for organic chemistry at the Collége de France.
     Director, M. Berthelot.
   - (*e.*) Laboratory for general chemistry and physiology at the École Centrale des Arts et Manufactures.
     Director, M. Dumas.
   - (*f.*) Laboratory for research and teaching practical chemistry at the Museum of Natural History.
     Director, M. Frémy.
   - (*g.*) Laboratory of physiological chemistry.
     Director, M. Pasteur.
   - (*h.*) Chemical laboratory at the École Normale Supérieure.
     Director, M. H. Sainte-Claire Deville (lately deceased).
   - (*i.*) Chemical laboratory at the Sorbonne.
     Directors, MM. Sainte-Claire Deville and Schutzenberger.
   - (*k.*) Laboratory for general chemistry at the Collége de France.
     Director, M. Schutzenberger.
   - (*l.*) Chemical laboratory at the Faculty of Medicine.
     Director, M. Wurtz.
   - (*m.*) Laboratory for teaching mineralogy.
     Director, M. Friedel.
   - (*n.*) Meteorological research laboratory at Choisy-le-Roi.
     Director, M. Renon.
   - (*o.*) Research laboratory at Caen for agricultural chemistry.
     Director, M. Isidore Pierre.

3. Natural history.

Committee, MM. Milne-Edwards, Claude Bernard (lately deceased).

(*a.*) Zoological Anatomical and Physiological Laboratory at the Museum of Natural History.
Director, M. Milne-Edwards.

(*b.*) Comparative Anatomy Laboratory at the Museum of Natural History.
Director, M. Paul-Gervais.

(*c.*) Laboratory of Experimental Zoology at the Sorbonne, with Maritime Station at Roscoff.
Director, M. H. De Lacaze-Duthiers.

(*d.*) Histological Laboratory at the Collége de France.
Director, M. L. Ranvier.

(*e.*) Laboratory of Zoological Histology.
Directors, M. C. Robin, M. G. Pouchet.

(*f.*) Histological Laboratory of the Faculty of Medicine.
Directors, M. Robin, and M. Duval.

(*g.*) Zoological Laboratory of the Lille Faculty of Sciences, with Maritime Station at Wimereux.
Director, M. A. Giard.

(*h.*) Zoological Laboratory at Marseilles.
Director, M. Marion.

(*i.*) Physiological (Teaching) Laboratory at the Sorbonne.
Director, M. Paul Bert.

(*k.*) General Physiological Laboratory at the Museum.
Director, M. Claude Bernard (lately deceased).

(*l.*) Histological Laboratory at the Collége de France.
Director, M. Claude Bernard (lately deceased).

(*m.*) Anthropological Laboratory.
Director, M. Paul Broca.

(*n.*) Pathological Anatomy Laboratory of the Faculty of Medicine.
Director, M. Charcot.

(*o.*) Physiological Laboratory of the Collége de France
Director, M. Marey.

(*p.*) Laboratory of Experimental Pathology.
Director, M. Vulpian.

(*q.*) Physiological Laboratory of the Montpelier Medical School.
Director, M. Rouget.

(*r.*) Botanical Laboratory of the Paris Medical School.
Director, M. Baillon.

(*s.*) Botanical Laboratory at the Museum of Natural History, Paris.
Director, M. Ed. Bureau.

(*t.*) Laboratory of Vegetable Micrography and its applications to Medicine.
Director, M. Chatin.

(*u.*) Agricultural Laboratory at the Museum.
Director, M. Decaisne.
(*v.*) Laboratory for teaching Botany at the Sorbonne.
Director, M. Duchartre.
(*w.*) Laboratory of Physical and Chemical Geology at the Collége de France.
Director, M. Elie de Beaumont (lately deceased).
(*x.*) Geological Laboratory at the Sorbonne.
Director, M. Hébert.
(*y.*) Geological Laboratory at Lille.
Director, M. Gosselet.

The fourth division consists of institutions for the study of historical and philological subjects, which are beyond the scope of this Report.

Note on the researches of M. Pasteur.

How far the laboratories in this imposing list are made use of by French students of science it is difficult to determine, but the opinions of M. Lauth, quoted in another part of our report, lead to the conclusion that for chemistry at least, there is much to be desired in this respect. However this may be, there can be no doubt that the foundation of these Écoles by the Government has been amply repaid, if in no other direction, by the magnificent series of researches by Pasteur, for which he now receives a Government subsidy of 1,000*l.* per annum. Commencing these most important researches many years ago with a critical examination of the phenomena of fermentation, Pasteur extended them to the investigation of the nature and mode of action of the minute organisms which cause many varieties of epidemic disease in the vegetable as well as in the animal world. He taught the brewer why his beer frequently turns sour, and how to enable him to keep it good; he showed the wine-grower how to prevent the fermentations to which wine is subject; next, turning his attention to the fatal disease which was killing all the silkworms in France and Italy, he indicated the cause of the complaint, and enabled the silk-grower to avoid the evil. Again his powers of exact observation were called in by the Government to combat the fatal disease known as anthrax, which was destroying the cattle and sheep in France to the number of 15 million per annum. By a happy discovery, Pasteur was able to check if not altogether to eradicate this pest. He found that by a certain method of culture, the poisonous character of the minute organism which is the active cause of the disease, can be so attenuated that it may be used to inoculate the healthy animal without producing any evil effects; and the animals thus inoculated are by this means rendered insusceptible of taking the disease in its aggravated form. By similar means he was likewise able to prevent the spread of a disease which attacks poultry and is termed chicken cholera; and at present Pasteur and others, including a commission of German men of science, under Dr. Koch, of Berlin, are engaged in an inquiry as to whether Asiatic cholera may not

yield to a similar treatment. A similar investigation appears to have led Dr. Friere, of Rio de Janeiro, to the discovery of the specific poison of the yellow fever, a discovery which points to a possible remedy for this virulent disease.

On the Influence of Technical Instruction on Certain Branches of Chemical Industry.

We have here collected our notes on certain special industries, viz., 1, chemical colours; 2, beet sugar; and 3, the alkali trade, upon which the influence of technical education is plainly observable.

I.—*Influence of Technical Training on the Chemical Colour Industry of Germany and Switzerland.*

Among the coal-tar colour works visited by the Commissioners, were those erected on the banks of the Rhine, at Basle, by Messrs. Bindschedler and Busch. These works, though far less extensive than those of Messrs. Meister, Lucius, and Brüning, at Höchst, or of the Baden Aniline and Soda Works, at Ludwigshafen, are carried on in a no less scientific spirit, and the general method of working adopted in all these establishments is identical. **Colour works of Messrs. Bindschedler and Busch.**

The first principle which guides the commercial heads of all the Continental colour works, is the absolute necessity of having highly-trained scientific chemists, not only at the head of the works, but at the head of every department of the works where a special manufacture is being carried on. In this respect this method of working stands in absolute contrast to that too often adopted in chemical works in this country, where the control of the processes is left in the hands of men whose only rule is that of the thumb, and whose only knowledge is that bequeathed to them by their fathers. **Employment of highly trained chemists.**

On entering the works of Messrs. Bindschedler and Busch, one is struck, in the first place, with the adaptation of means to ends, with the substantially-built, well-lighted, well-ventilated workshops, and above all, with the all-pervading cleanliness and neatness. But it is not of these things that we now desire to speak, but rather of the method by which their business is conducted. In the first place, then, the scientific director (Dr. Bindschedler) is a thoroughly-educated chemist, cognisant of, and able to make use of the discoveries emanating from the various scientific laboratories of the world. Under him are three scientific chemists, to each of whom is entrusted one of the three main departments into which the works are divided. Each of these head chemists, who have in this instance enjoyed a thorough training in the Zurich Polytechnic, has several assistant chemists placed under him, and all these are gentlemen **Method in which the works are conducted.** **Training of heads of departments.**

who have had a theoretical education in either a German University or in a Polytechnic School. An important part of the system has now to be noticed, viz., that directly under these scientific assistants come the common workmen, who have, of course, no knowledge whatever of scientific principles, and who are, in fact, simple machines, acting under the will of a superior intelligence. The many and great advantages of this arrangement are patent to all; and the fact of having men of education and refinement in positions of the kind, renders the foreign manufacturer who adopts this system less liable to annoyance and loss (from sources which we need not more nearly specify) than his English competitor, who works on a different plan.

Ten chemical laboratories.

So much for the *personel* of the works. Now for the mode in which they carry on their work. To begin at the beginning, we find no less than ten well-equipped, airy, experimental laboratories in these works, perfectly distinct from the workshops where the manufacturing processes are carried on. In these ten laboratories, the chief departmental chemists and their assistants work out their investigations respecting the production of new colouring matters, or the more economic manufacture of old ones. To assist them in their work, a complete scientific library is at hand, containing all the newest researches, for these, as we have said, form the material out of which the colour-chemist builds up his manufacture, and no sooner do the results appear of a perhaps purely scientific research which may possibly yield practical issues, than the works-chemist seizes on them and repeats these experiments, modifying and altering them so as at last to bring them within the charmed circle of financial success.

Scientific library.

Mode in which new scientific discoveries are worked out.

Thanks to Dr. Bindschedler, we are able to quote a specially representative case, and a clear description of one such case is worth a host of generalities. Through the original investigations of Messrs. Emil and Otto Fischer, the attention of the manufacturer was drawn to the leuco or colourless base obtained by the action of benzaldehyde on dimethylaniline, inasmuch as they stated that the salts of these colourless bases become green on exposure to air. Founded on these observations, an endeavour was made to effect the practical manufacture of a green colouring matter by oxidation of these colourless bodies. In order to attain the desired end, the following investigations had to be made by the chemist and his assistants who were to conduct the operations:—

(1.) A cheap method had to be found for manufacturing benzaldehyde.

(2.) A profitable mode of making the leuco-base had to be worked out.

(3.) The proper oxidising agents and their best method of application had to be determined.

(4.) The best method of purifying and of crystallizing the green colouring matter had to be discovered.

Laboratory experiments are succeeded by work on a manufacturing scale.

The laboratory experiments on the above points having proved so far successful as to give prospects of good results, operations on a somewhat larger scale were started, and these yielding a satisfactory issue, the manufacture proper of the colouring matter, now well known as malachite green, on the technical scale was commenced; all the operations being watched by, and constantly being under the control of the chemists. But even now their scientific work is by no means ended. Continuous laboratory experiments go on for the purpose of finding improvements in the mode of manufacture. Thus, for example, the improved yield, both as to quality and quantity, of the benzaldehyde is a matter of investigation. Again, the synthetic production of the pure leuco-base by a more direct process is sought for, so as to get rid of loss in working, and to obtain a yield as close as possible to that pointed out by theory. In the same way improvements in the materials used for oxidation, and in their application, are made, so as to effect the oxidation quantitatively, without the formation of by-products. Lastly, the action of various solvents is examined, so as to obtain the best form of the crystallized colouring matter. As indicating the value of these improvements made after the colour became a marketable article, it is only necessary to state that the price of the crystallized oxalate has been reduced from 2*l.* to 1*l.* 4*s.* per kilo.

All the great colour works give employment to numerous chemists.

The foregoing may serve to give a picture of a really scientifically-conducted works, where each step in advance is made systematically, as the result of a well-devised plan of operations. This is, indeed, the only means of progress, and this fact is so well recognised in Germany that each of the much larger colour-works at Höchst and Ludwigshafen possesses a staff of from 30 to 40 well paid and thoroughly trained chemists to conduct their operations. But we are, of course, far from believing that because the methods adopted in these foreign colour-works are scientific and productive of good, those made use of in all English works must therefore be unscientific and bad. Taking the whole applications of chemical science we may, no doubt, with truth say that the English industrial chemists have been at least as successful commercially, and certainly as productive in new and important discoveries, as their Continental rivals. The Germans and Swiss, however, have been and still are distinctly before us, not only in the facilities which they possess of obtaining the highest technical training in their numerous Universities and Polytechnic Schools, but what is even more to the point, before us in the general recognition of the value and importance of such training for the successful prosecution of any branch of applied science.

Works of Messrs. Meister, Lucius, & Co. at Höchst.

The following statistics give some idea of the magnitude of the colour works of Messrs. Meister, Lucius, & Co. at Höchst, near Frankfort, referred to above, and founded in 1862.

The establishments occupy an area of 150 acres, of which 20 are covered with buildings. The staff includes 51 scientific chemists, 50 foremen, 15 managers and engineers, and 77 clerks and commercial men, with 1,400 workpeople. The works possesses its own railways, 41 boilers, with a heating surface of 4,000 square yards, and 71 motors, either steam, water, or gas-engines. The workmen and officials are domiciled in houses belonging to the company, and restaurants, baths, sick clubs, and pension funds have been established for the good of the employés. There is also a fire-brigade with 5 hand-engines, and one steam fire-engine. The total supply of water, from 145 fire-cocks, amounts to 30,000 cubic feet per hour.

Manufactured products in 1882.

In 1882 the products of these works amounted to:—

(1.) 6,600,000 lbs. weight of alizarine.
(2.) 2,200,000 „ aniline oil.
(3.) 1,540,000 „ aniline, resorcin, and napthol.

Colours.

Colours, &c.

The following are the separate products classed together under the last head:—

Aniline and aniline salts.
Fuchsine (no arsenic acid is used in its preparation).
Methyl violet.
Green and blue colours.
Eosin colours.
Napthol colours.
Alizarine and artificial indigo.
Quinolin derivative (kairin a new substitute for quinine).
Acids.

Raw products used.

The most important raw materials employed in manufacturing the foregoing products are as follows:—

40,000 tons coal.
3,000 „ tar products.
2,400 „ caustic soda.
400 „ potash salts.
2,900 „ carbonate of soda.
17,400 „ sulphuric acid.
10,100 „ various other acids.
1,500 „ iron borings and filings.
250 „ wood spirit and spirits of wine.
1,000 „ various chemicals.
6,800 „ common salt.
2,050 „ carbonate of lime.

Acids are manufactured on works.

The whole of the sulphuric, hydrochloric, and nitric acids used, is made on the works.

From about 70 to 80 per cent. of all the aniline colours manufactured are exported, the remainder used in Germany.

About 90 per cent. of the total make of alizarine is exported chiefly to England, but considerable quantities find their way to America, Russia, France, Holland, Spain, and Italy. Exports.

One of the most recent and most interesting additions to the above list of products is a derivative of quinolin, termed kairin, lately discovered by Emil Fischer. This substance, which is now being made at Höchst at the rate of about 22 lbs. daily, has been shown to possess important febrifuge properties, even exceeding quinine in activity, and it is not impossible that this artificial product obtained from coal-tar may be the means of supplanting altogether the natural alkaloid. The importance of this discovery, should it serve the above purpose, can of course hardly be overrated, and it will then add another and most striking example to the numerous ones which already exist, of the immense importance to the human race of researches in purely scientific organic chemistry, which, at one time, appeared to have no practical value or possible application. It may, therefore, serve again to point the moral, which cannot be too strongly insisted upon, that it is only by the highest and most elaborate achievements of pure scientific investigation that the greatest practical advantages to mankind can be secured. Manufacture of a new alkaloid.

II.—*Influence of Technical Training on the Beet-sugar Manufacture.*

Probably no more striking illustration of the rise of a successful and most important industry depending upon the application of the scientific principles of engineering and chemistry can be found than in the Continental beetroot sugar manufacture. The increase in the consumption of sugar in this country has been very great. In 1843 it amounted to 200,000 tons; this figure was doubled in 1854; in 1874 it reached 850,000 tons, and in 1882 1,000,000 tons of sugar were consumed in the United Kingdom. Of these quantities in 1870, 165,000 tons consisted of beetroot sugar, whilst in 1882 the total was over 400,000 tons, valued at 10,000,000*l.* The whole of this amount is imported from Belgium, France, and Germany, as no beetroot sugar is manufactured in this country. Manufacture of beet sugar.

To show the extent and growth of the Continental industry in a small country, we may cite the case of Belgium, with a population of 5,600,000. In 1846 the area under cultivation for beetroot was only 5,421 acres; in 1866 this was increased to 44,480 acres, and in 1882 to 86,490 acres. The quantities of raw beet-sugar manufactured in Belgium were in 1880–81 68,000; in 1881–82 73,000; and in 1883 probably 80,000 tons were manufactured in 156 works; that is, about one ton of sugar is obtained from one acre of beetroot crop. In France and Germany the area of beet crop and the consequent production of sugar is very much larger. The processes of extraction and purification of sugar from beet are complicated and delicate, Growth of the Continental industry. Beet cultivation in France and Germany.

requiring both scientific knowledge and capital, as the plant necessary for working up the juice into refined sugar is of a very costly character, and the operations require careful and scientific handling in order to ensure success. The juice contains not only sugar crystallizable and uncrystallizable, but also a considerable quantity of inorganic salts and organic substances other than sugar, and the presence of these latter ingredients prevent a large portion of the sugar from crystallizing, and therefore require to be removed. This removal of the injurious constituents can only be effected when an exact analysis of the juice and of the sugar has been made, and this must be done at each stage of the operation, so that the mode of working shall be properly regulated, and such an investigation is a somewhat complicated process, needing skilled chemical knowledge. The quantity of sugar which is rendered uncrystallizable by the presence of inorganic salts or ash is about five times the weight of the ash.

Importance of systematic analysis of the juice.

Employment of the strontia process.

In order to obtain the sugar which would otherwise be thus lost, many processes have been adopted, and of these that involving the use of strontia is the most recent. This method was secretly worked for some years in certain works in Germany, but it has now been generally adopted under the patent of Dr. Scheibler, chemist to the Beetroot Sugar Institution. By the use of the strontia process large profits have been made, and the plan has been successfully introduced into France and Belgium. The Continental beetroot sugar manufacture, partly of course in consequence of the Government bounties, has been a very profitable one; annual dividends as high as 100 per cent. having been paid by some sugar-mills. It would seem, however, that owing to the great increase in the number of these establishments, the trade has seen its best days.

Cultivation of beet root in the United Kingdom.

The question of the cultivation of sugar beet in the United Kingdom, and especially in Ireland, though it has received a certain amount of attention in various quarters, has not come to any practical issue. About 1850 Lord Clarendon, then the Lord Lieutenant of Ireland, ordered an official inquiry on the subject of the growth of beetroot in that country, and the results of that inquiry, presented to Parliament in 1852, showed that 78 per cent. of the beets grown in Ireland were rich enough in sugar to be worked, whilst the corresponding amounts for England and Belgium were 75 and 70 per cent. respectively. At that time the West India sugar had the command of the market; the sugar trade has, however, since that date been revolutionized, but no step has yet been taken by agriculturists and capitalists to commence the growth of sugar beet and the manufacture of beet sugar in this country. To produce the 400,000 tons of beet sugar now imported from the continent should need as many acres, but as the beet crop is taken every three years the total acreage required would be

Acreage needed to grow the amount of imp sug

1,200,000. A large proportion of this, if not the whole of it, could be found in Ireland, and there can be no doubt that the introduction of such an industry would do much to improve the general agriculture of that country.*

[For further information on the Belgian Beet Sugar Industry, *see* paper by M. Melin of Wanze, read before the Liége meeting of the Institution of Mechanical Engineers, 1883.]

III.—*Influence of Technical Training on the Alkali Manufacture.*

Continental and English alkali works.

The beneficial action of high scientific and technical training upon the chemical colour and beet sugar industries, having thus been shown, it becomes of interest to examine the effects of such education on another no less important branch of chemical manufacture, viz., the alkali trade, and in this instance the comparison of the relative position of the continental and English works is by no means all in favour of the former. In the first place, as regards the workmen themselves, it may be truly said that in no country does any real amount of scientific education reach the ordinary workmen in alkali works who are rather labourers than artizans. Moreover, the foremen, both in this country and abroad, are almost invariably men who entered the works either as laboratory boys or as ordinary workmen, and who have risen by virtue of industry and native intelligence, but who have had no scientific training beyond that afforded by the occupation in which they have been engaged. So far, therefore, as the education of the workmen employed in alkali works is concerned, the foreigner has no advantage over us, nor have we any over the foreigner. In the case of the managers and proprietors the matter is, of course, different. On the Continent nearly every manager of a soda works is a man of a very high degree of scientific attainment,—a highly trained engineer, and a highly trained chemist. An English manager, one at least of the older school, on the other hand, is scarcely ever a man who has had a similar training to that of continental managers before they enter upon the duties of management. The continental alkali makers are men of wider knowledge and of more extended scientific attainments than their English brethren. Thus, whilst probably none of our English alkali makers could discuss the chemistry of the latest organic colouring matter, nearly all the continental masters are able to do so. But in the opinion of those best qualified to judge, and speaking of course of the managers of the first class works in each case, there is no doubt that the English alkali makers are just as well acquainted with the scientific bearings and

Education of the ordinary workmen.

Education of managers and proprietors.

* The sugar factory of Mr. Duncan, established some years ago at Lavenham, and which was not successful, is about to be reopened. The use of strontia and other improvements in the manufacture, together with lower railway charges on the roots, encourage the new proprietors to anticipate better results.

relations of their own manufacture as their continental rivals. Nor is the foreigner a better alkali maker than the Englishman, for even in cases in which the former obtains better results than are usual in this country, as regards economy of fuel and raw material, the cause is to be sought rather in the fact that his cheaper labour permits him, and his dearer fuel and raw material compels him, to do what dear labour and cheap fuel and material absolutely forbid to the English alkali maker, than in any superiority in scientific training of the one over the other. It certainly cannot be said that the English soda industry suffers in comparison with that of the Continent, owing to the want of scientific knowledge on the part of those who conduct it. Men of the highest talent and most eminent for their scientific knowledge are found in all our large alkali works, and it is a remarkable fact that with one or two exceptions, everything in the way of important improvements in the alkali manufacture by the Leblanc process, has originated in England. Hydrochloric acid condensing towers, revolving black-ash furnaces, Glover-towers, mechanical calcining furnaces, mechanical salt-cake furnaces, plus-press furnaces, and last but not least, the Weldon plant; each one of these English improvements marks an era in the alkali manufacture, and has been at once adopted as a necessity by all manufacturers. Even the well-known ammonia-soda process, first successfully worked in Belgium, is chemically an English invention (Dyer and Hemming), though made industrial by a Belgian (Solvay). No less remarkable is it that, certainly often in England, and in some cases abroad, those men who have made the most important improvements or discoveries in the alkali manufacture have been self-taught, proving the truth of the axiom that a scientific education cannot stand in place of natural sagacity and workshop training.

All the more prominent improvements on the Leblanc process have been discovered in England.

It is the opinion of those intimately acquainted with the present condition and future prospects of the alkali trade, both at home and abroad, that such differences as exist between the results obtained on the Continent and at home, are due to differences of national character and local circumstances rather than to a superiority of scientific education, and it may be questioned whether many continental alkali works could survive in face of English competition, if the import duties by which they are at present protected were abolished.

Foreign alkali works do not owe their position to technical education.

ART SCHOOLS, GALLERIES, AND MUSEUMS.

The question of providing museums of art and industrial objects for provincial towns, is still almost in its infancy in this country. And though Birmingham, Liverpool, Nottingham, and recently Manchester, have established promising art galleries; and in other large towns also some interesting collections exist, there no provision of this sort at all comparable with the

Provincial and art museums in this country still in their infancy.

amply furnished museums and galleries possessed by many provincial towns on the Continent especially in France.

Influence of similar museums on continental industries.

It cannot be disputed that to the influence of these collections, and to the direct bearing they have on art and industrial training, is due much of that abundance of art resource which is so advantageous to many French industries and manufactures. Though we can scarcely hope to obtain in our provincial towns within an early date, such collections of rare pictures as have been acquired in some foreign towns through the influence of old traditions and special causes of distribution, much is possible for us, in the direction both of augmenting our present resources and of bringing them to bear with greater effect on our art manufactures, and in vastly increasing the artistic power of our skilled artizans.

Provincial museums in France.

In the case of France, which stands at the head of artistically educated countries, the provincial museums have been largely assisted by the State, both by money and by contributions of pictures and other objects. The surplus stores of the Louvre are freely given to such galleries, and the supply of good copies and casts for the art schools is administered with a lavish hand.

It would, however, be erroneous to suppose that foreign provincial galleries lean entirely on the support of the Central Government. The magnificent gifts and bequests of private individuals to the galleries of Limoges, Montpellier, Dijon, Nancy, Lille, and other towns, bear witness to the fact that local effort and enterprise are by no means exclusively British virtues, and they prove also the high value which the presence of a local gallery has, in stimulating the taste and attracting the munificence of the inhabitants.

Limoges Art School and Museum.

At Limoges the splendid collection of enamels and pottery, nearly all due to private gifts, has a direct and most valuable bearing on the local porcelain industry. The Art School is under the same roof as the Museum, and at this school some 1,200 students, chiefly of the artizan class, receive gratuitously a sound technical instruction, not only in the principles of decorative art, but also in the direct and practical application of art to the chief manufactures of the town. The same may be said in some degree of Tours, where the Museum and Picture Gallery are in direct connection with the Art School, and the teaching is adjusted to help skilled industry as well as to give a pure art training. The public art schools of Lyons also, while holding a high position as centres of pure art teaching, do very much to serve the local designing; and the collection of artistic fabrics, and of drawings and designs connected with the silk trade, forcibly illustrates the value of local effort and management in advancing the interest of special artistic industries.

The porcelain painting of Nantes, and the glass painting of Angers, owe very much to the direct teaching of their art schools, and to the admirable illustrative collections they possess.

Art schools and museums in every

It may be broadly asserted that every French provincial capital possesses not only an efficient school of art, but a picture

French provincial capital.

gallery and museum, either of industrial or antiquarian interest, and also a good library. Nor is it found that these influences tend mainly to the creation of picture painters. That department of art is not specially encouraged, the main function and utility of their art teaching being in its application to local trades and industries.

Control and management of art museums in France.

As the State joins with the local municipal body both in providing the budget and in supplying the art collections for provincial galleries and art schools in France, so the control and management of these institutions are of the same joint character. The State appoints certain leading officials and directors, while all matters of detail are conducted generally by the mayor and a small committee of management. It seems a very useful and even high view of the duties of a municipality that its resources and influence should be thus applied to the advancement of art; and so much is this obligation recognised in France that the museum and gallery are now well established provincial institutions; some are of high value, others, perhaps, are of less worth, but all tend to an elevation of taste and industrial skill.

Liberal State grants made for casts and models.

Special notice is due to the abundance and excellence of the casts and models in nearly all the French art schools and academies. These are freely and gratuitously supplied by the State, and no request for them is ever refused by the central authorities. The prominence given to modelling in all the French State-supported schools is a feature of marked value, and contrasts forcibly with the meagre attention bestowed on that essential branch of art teaching in our own schools. Though the provincial art training of France is *mainly* directed to industrial ends, very ample provision is made in all the chief schools for the transference of promising pupils to complete their studies at the École des Beaux Arts in Paris at the public expense.

German art and industrial museums

In many of the principal towns of Germany we found also excellent and well arranged art museums, some of them occupying the same buildings as the Schools of Art. This was the case at Berlin, where, chiefly owing to the efforts of the Crown Princess of Germany, an admirable Museum of Works of Art has been brought together, on the model of the Museum at South Kensington, its avowed prototype. This museum contains fine collections of pottery, porcelain, enamels, metal-work, textiles, wood carvings, and decorative art workmanship. It has been arranged with special reference to the use of the art students, but it is freely opened to the public for study and recreation.

Vienna Museum.

At Vienna there is likewise a close and intimate connection between the school and the museum, and the admirable collections of ornamental art have been largely acquired with the view of aiding and supplementing the teaching of the professors in the art schools, which are conducted in the same building.

Dresden Museum.

The Museum of Industrial Art at Dresden is a model of the manner in which collections of art objects may serve to illustrate

and bear upon the instruction given in the schools. The collections occupy the ground floor of the building, formerly occupied by the Polytechnic School, and the Art school is carried on in the rooms above. Under the able direction of Professor Graff, the students make large use of the fine collections of textile fabrics, majolica, glass, furniture, and metal work, and in a special room in the museum has been brought together a most interesting display of modern furniture, leather work, glass, porcelain, metal work, textiles, and almost every description of art manufactures, by workers in Dresden and its vicinity, from designs by the students and masters of the school. This latter feature is one we did not notice elsewhere, but which appears to us to be well worthy of imitation. We should specially notice the library at this museum, which contains many thousands of designs for art workmanship, mounted on cards and arranged in boxes for facility of reference, each box consisting of some 60 or 70 sheets of designs for some special object, thus "chalices," "lace," "book covers," &c. This section of the library alone contains above 27,000 sheets of designs.

Dresden industrial art library, and collections.

At the admirable Industrial Art Museum at Nuremberg this plan of arranging designs was, we believe, originated. The collections at Nuremberg, though on a smaller scale than those at the more important towns we have already named, are very complete and are extremely well chosen. Some art teaching is carried on at this museum, though a completely equipped art school does not form part of the scheme. There is a class for bronze workers and electrotypers, and excellent practical work is done. Copies are produced of the art objects in the museum, for distribution to other parts of Bavaria, and some desirable exchanges have been made with other museums. As these foreign museums become more numerous, some larger and more extended system of international exchanges between England and the Continent than that already in operation may be introduced with advantage.

Nuremberg Industrial Art Museum.

The Museum of Industrial Art Workmanship at Munich is probably the most extensive on the Continent. The collection of textiles is very important, and though no school is, we believe, attached to the Royal Museum, every facility is given to art students to make large and free use of the collections.

Munich Industrial Art Museum.

At Zurich the Commissioners found at the Industrial Art School an excellent museum of ornamental art, collected for purposes of study. This museum has only been established for a few years, but it is already rich in metal work and wood-carving.

Zurich Industrial Art School and Museum.

In some of the smaller German towns, permanent collections of art workmanship are brought together in the Gewerbe Hallen or Trade Halls. These are very frequent in Baden and Wurtemberg. Together with the best examples of modern artistic work we found displays of art-reproductions, collections of textiles, and frequently special retrospective collections, relating to the chief industry of the district. In the Central-Stelle at Stuttgart is an excellent museum somewhat of this character, and in numerous

German Gewerbe Hallen or Trade Halls.

small towns of the Black Forest we found flourishing museums, largely aided by grants and loans from the Government collections at Carlsruhe.

System of South Kensington Loan Collections unknown on the Continent.

It is certain that no Continental country can boast of such an admirable system of loan collections as that supplied by the Science and Art Department at South Kensington, and it would be well if even this supply, large as it now is, could be still further increased, and the collections allowed to remain for longer periods in the towns to which they are sent. As an example of what may under existing conditions be achieved in this country by means of local effort, we cannot do better than point to the splendid art gallery and museum at Liverpool, which is almost entirely due to the munificence of local benefactors. The building for the Derby Museum of Natural History, the bequest of the Earl of Derby, valued at 50,000*l.*, was erected by Sir W. Brown at a cost of 40,000*l.*, and the museum has been further enriched by the unique collection of historical art presented by Mr. Jos. Mayer, F.S.A. We are informed that the museum is visited by manufacturers and artizans from the Staffordshire Potteries, for the sake of the valuable collection of ceramic ware which it contains. Subsequently Sir A. B. Walker erected and presented the magnificent art gallery at a cost of nearly 40,000*l.* In the same group of buildings are the free library and lecture hall. The cost of the entire block has been little short of a quarter of a million sterling.

Liverpool Art Galleries and Museums.

Manchester Art Gallery and Museum.

The public art gallery of Manchester has quite recently been established under the powers of the Manchester Corporation Act, 1882, by which the Corporation became possessed of an old foundation, the Royal Manchester Institution, in the building of which the art gallery is now accommodated. The well-known "Bock" collection of ancient textiles has been purchased by the Corporation as the commencement of an Industrial Art Museum, especially of service to designers engaged in the staple trades of the district. We are glad to observe that the Art Gallery and Industrial Museum are open on Sundays during the winter between the hours of two and nine p.m., free to the public, and we learn that they have been visited by crowds of artizans and their families; the number of visitors on the four Sunday afternoons ending January 6, 1884, having been 10,308. Their conduct was without exception exemplary, great interest being shown by the visitors in the different works on view, particularly when the subject was thoroughly explained to them. Nor must we forget to mention in this connection the conversion of the castle at Nottingham into a public museum and art gallery, likewise supported by the Corporation of that town, as well as the valuable Industrial Museum at Edinburgh connected with the Science and Art Department.

Nottingham.

Edinburgh.

Assistance to provincial museums.

Short of a complete re-organization of the principles on which our national art institutions are administered, it would be difficult to suggest a plan by which the right of large provincial centres of industry to share the advantages of the national art treasures

and Imperial support could be fully and practically recognised; but even under our present disjointed administration, deficient as it is in parliamentary responsibility, some more liberal provision might be made, both in money grants and in the premanent gift of surplus objects and reproductions, for the endowment of provincial museums and galleries. Such gifts, and the general character of the collections themselves, should have special relation to the trades and industries of the various localities; and an intimate connection should be established between the metropolis and provincial towns in all art matters.

The small degree in which our art schools, with few exceptions, are now contributing either to industrial or designing art, is only too well known, and a marked change in this respect is essential before our schools can hope to take rank with those of the Continent in direct commercial utility. And to this aim no more valuable accessory can be provided than that of museums well supplied with examples bearing on the trade or industry of the town or district, and placed, if possible, in the same building with, or in close proximity to, the School of Art.

Municipal and other local authorities, as well as the ratepayers at large, should be induced by every means to acknowledge and discharge the responsibilities they are under to the community in this respect; and by the expansion of their powers under the Free Libraries Act they should be enabled to make ample provision for the endowment, maintenance, and management of museums and galleries, fitted not only to supply the means of higher artistic study and elevating recreation, but to serve directly in the improvement and development of existing industries, and in the acquisition of new branches of trade and employment for the skilled workmen of our country.

Municipal authorities should provide museums.

Conversations on Artistic and Technical Instruction.

The Commissioners attended the opening of the Fine Art and Industrial Exhibition at Nuremberg on the 15th of May 1882, and had some interesting conversations with some of the leading educational officials who were present at the ceremonial. Among these were Professor Lange, director of the Kunstgewerbe School at Munich, and Professor Mayer, of the Kunstgewerbe School of Nuremberg, each of whom gave important information as to the working of the art schools of Bavaria, and their effect upon the industries of the State. The two schools represented by these professors are among the most important in Germany. The Munich school (page 159) is one of the most modern in construction and arrangement, and the Nuremberg school (page 160) was referred to by the French Commission on Technical Instruction in 1863 as the school which had "contributed, more than any "other, to the progress of the national industry" of Germany.

Industrial Exhibition at Nuremberg, 1882.

It was explained to us that the entire object of the exhibition was to obtain as complete a picture as possible of the condition of Bavarian industries, and of the work of the schools by which the

Object of the exhibition.

industries were being promoted, so that, by comparison with what had been exhibited in other countries, the Bavarians might see what could be done for the improvement of their own. A large section of the exhibition had, therefore, been devoted exclusively to the exhibits from technical schools of every kind, and from all parts of the country (including schools for designing and needlework for women), and as these exhibits from the different schools would be examined by the teachers and promoters of other schools, it was expected that a great stimulus would be given to technical instruction generally.

Influence of the art schools upon manufactures.

The professors stated that the conviction is universal throughout the country that the various art and technical schools are exercising a most important influence upon their manufacturing industries. In their belief, they can only meet the competition of their rivals in their own and other countries by training their workmen in taste and skill, and their industries will prosper in proportion as they keep up the efficiency of their schools, and spread their influence among the workers themselves. On all hands this movement is progressing, and they are compelled to strain every nerve in order not to fall behind. And what is the result? They can see a superior taste in every object made by hand, as an outcome of these schools; and they can now almost tell by the work, where the workman or designer has been trained. Taste has become almost like a man's handwriting, and they can recognise the man, or, at least, his school, in his work. The great Nuremberg craftsmen of old have not ceased to inspire their followers with some of their enthusiasm and noble feeling, although centuries have passed since they lived and worked in this city. The inhabitants are all proud of the old couplet—

> " Nuremberg's hand
> Goes through every land;"

and they claim that it is no mere figure of speech. And, if the artistic supremacy of Nuremberg is not so marked at present as in olden times, it is because of the spread of art culture in other communities. Other influences materially interfere with the localisation of art industries. In these days of quick and easy travelling, the fame of a school attracts students from a long distance, and clever students belonging to the town in which a good school is located, often find it advantageous to remove to places less favoured, and there sell their cultivated talent to capitalists who can utilise it to their profit. Thus, not in Bavaria, or even in Germany only, but in many other parts of Europe, are designers and art workmen, who have been trained at the schools of Nuremberg and Munich, who now enrich the industries of their new homes.

Drawing a necessary groundwork.

The Kunstgewerbe schools of Munich and Nuremberg having been eminently successful in the training of industrial designers and art workmen, the professors were interrogated as to the methods adopted in the training of their students. They insisted

that the student must first be taught to draw thoroughly, drawing being the language of his profession. "The groundwork "of all design that is worth anything is art. If the student "has any talent or art-feeling within him, his power of drawing "will enable him to give it expression; but, without thought "and imagination, there can be no originality of design. Mere "knowledge of drawing will not make a man a good artist any "more than knowledge of language will make him a poet; but "designer and poet are helpless without the knowledge of the "language by which their art can be expressed to others. "Teachers need to study the peculiarities of their students, for "all cannot be dressed in the same clothes, or combed with "the same comb."

How artists become designers.

When asked what were the considerations which usually prompted artists to become designers, the professors were of opinion that the most effective incentive in prompting an artist to become an industrial designer is the pressure of necessity. All art students are ambitious, and some are vain enough to believe that they possess the genius of a Rubens or a Raphael; it is not the business of a teacher to dispel these illusions from the minds of dreamy youths; a little contact with the world does all this for them. They have an ambition to paint pictures, and they *will* paint pictures, and it is only when they find that their pictures cannot be sold that they turn their attention heartily to the making of designs for furniture, wall-papers, textile fabrics, or any other objects that come to hand.

Occupations of students.

The students are drawn from all classes of society, except the highest. Many who go through the full three years' courses are the sons of small manufacturers of artistic objects. In Germany, the proportion of men in small industries, or who have small workshops in their own homes, is very large, as compared with England. Many students, especially those connected with building and out-door trades, only come in the winter, when out-door work is often suspended. Some intend to become teachers, and, as there are no normal schools in Bavaria for training teachers of drawing, these high schools are, to some extent, utilised by them. Such students are required to go through the technical courses according to the school programme, and their numbers—attending the Munich and Nuremberg schools—are really decreasing. On being asked if any students besides those attending only in winter, support themselves while attending the classes, Professor Lange stated that from seven to eight per cent. of his students at Munich may be called "half-timers," working outside the school a number of hours daily, often selling their designs or work in wood carving, modelling, glass or porcelain painting, &c., executed either in the school or out of it. At present the number of students of the artisan class, who have been engaged in practical work before coming to the schools, or who do practical work out of school hours, is increasing. Such students, in the opinion of both professors, are

generally the most successful. They come, as a rule, after two or three years' work, when they have begun to feel their deficiencies, and are really anxious to improve themselves. They may have, in the first instance, less expertness in drawing than the schoolboy of 16 who has enjoyed continuous instruction from his childhood, but, having had experience of practical work in a definite trade, they know what they want to learn, and they work with greater care and perseverance. One of the professors, in 1876, attended a congress of professors and promoters of design and art work, and the question was seriously discussed as to whether, in the first place, students should not be required to work at some trade for about two years before coming to the Kunstgewerbe school; and, in the second, whether apprentices engaged in art work should not be compelled to attend the school also. The congress was unanimous as to the importance of the dual principle, that the designer should know something of practical work, and the practical workman something of design, but could not see its way to make it compulsory. At the Nuremberg school there are, in winter, 120 students who earn their livelihood by day, and study art in the evening. Some of the most valuable work in the school is executed by these students.

Bursaries.

As a help to the attainment of higher art instruction by poor artisans, 64 bursaries are given by the State of Bavaria, besides 10 private exhibitions, each of about 18*l.* annual value, enabling students to attend the Kunstgewerbe schools. There are also travelling studentships, the holders of which are required to make sketches and descriptions of what they see in their travels. On their return, their notes and sketches are submitted to the director of the school in which the prize was obtained, and are often retained as the property of the school. We saw some of the sketches, which were always interesting and sometimes very clever.

Help from Fortbildung schools.

The Kunstgewerbe schools of Bavaria are greatly helped by the ordinary Fortbildung or night schools, which apprentices are required to attend during the evenings and on Sundays. These schools are almost invariably free; they supplement and continue the education received in the day schools, and are taken advantage of by middle-aged as well as by young men, desirous of improvement. They are technical in the truest sense of the word; science and drawing are taught, in their bearing upon the industries of the students. The Fortbildung schools are nurseries which are constantly sending earnest students to the Kunstgewerbe schools, where their particular tastes are cultivated in the direction in which they can be made most useful. But for these intermediate schools, some of the cleverest designers and best art workmen would never have been discovered, for they would not have been induced to take the first steps in art culture, by which alone their talent was brought to light. The professors drew our attention to the very excellent examples of modelling,

wood-carving, and smiths' and mechanics' work sent to the Exhibition by several of the Fortbildung schools of Bavaria, work which, had it been done by any provincial art school in England, would have materially enhanced its reputation.

Evening classes in Art Schools for artisans.

Although everything is done to encourage students to enter the prescribed courses of art instruction in architecture, sculpture, designing, and metal and wood work, yet admission to the schools is freely granted to those who have neither time nor means for taking up these full courses. Evening work, for instance, which is usually taken advantage of by artisans, is not generally specialised so as to fit the exact wants of particular trades. It would be impossible for a teacher to do justice to a class if each student took an independent line of his own; one carving on wood, another lithographing, a third metal-chasing, and so on. The classes are, therefore, held for the teaching of art generally, as in the free evening drawing schools of Paris.

French and English methods of teaching drawing compared.

One of the professors was familiar with the French method of teaching, and admired it. He considered that the free use of charcoal and the stump are effective as encouraging originality, boldness, and dexterity, but that there is a danger of precision and careful finish being sacrificed by this system. The South Kensington method, which seemed to him to make everything subservient to exact outline and careful shading, is also admirable in its way, but, just as the French method produces carelessness, the English method erred on the side of timidity. In Paris the system of constant competitions, instituted for the purpose of encouraging the students, is detrimental to the pursuit of the higher branches of art. They may be important as stimulating the energy and inventive faculties of slow or dull students, but they tend to the exhaustion of the finer faculties of many of the most talented youths. "Genius in young men" said our informant "needs oftener to be restrained than to be pushed "forward, and constant competitions encourage some of the "most prominent students to rush by leaps and bounds to the "higher realms of pictorial representation before they have "mastered the elementary rules of drawing and colouring."

Importance of good examples and casts.

The importance of good examples and casts as copies, was insisted upon by the professors. At the Munich school is an important collection of casts, the work of the students, and used for decorating the central hall and staircase. At Nuremberg the director was sent on an expedition many years ago to Italy and France, with a commission to visit the chief galleries and schools and to buy all the casts that he considered suitable for the purposes of this school.

Influence of picture galleries.

On being asked as to the influence of picture galleries, the professors considered that picture galleries and museums, furnished with original works or copies from the best masters, are as necessary for the cultivation of art as libraries are for the cultivation of literature. They materially assist in cultivating

and shaping the taste of designers, and elevate the taste of buyers. Good work is thrown away upon people who cannot appreciate it, while bad work is offensive to persons of educated tastes. Picture galleries are therefore useful as well as enjoyable places of resort to all classes in an industrial community.

Apprenticeship system.

Our informant had a word to say on the apprenticeship system. Modern civilization had almost crushed it out. In olden times every workshop was a school, and the "werkmeister" was an artist as well as a handicraftsman. The apprentice went through his course of seven years' apprenticeship and learned every detail of his master's business. All this has now changed, the workman is ceasing to learn his trade. What with the exigencies of the military system, and the increasing division of labour, the training of the workman in the old-fashioned way is impossible; he may learn a part of a trade in the workshop, but he seldom learns the whole of it. It is therefore all the more important that the school should step in and supply, as far as possible, the defects of our industrial system. Each trade has its theoretical as well as its practical side, and, considering that the workshop does less for the training of the apprentice than before, it is necessary that the school should do its part as thoroughly and systematically as possible. These schools represent the faith of the people, expressed on all hands, and supported by daily experience, that taste is one of the most important factors in industry. From nearly every trade the cry comes for more taste, more skill. It is not now a mere sentiment, that prompts governments and municipalities to make great sacrifices for these schools. They feel that the prosperity of their industries depends entirely upon the cheapness and attractiveness of their productions, and although the workshop may do something for the former, the latter depends upon the taste and skill of employer, foreman, or artisan. As practical evidences of their success, these gentlemen conducted us over some departments of the Exhibition, in which the influence of their schools upon the workmanship of countless objects of manufacture was unmistakeable.

Conversation with Professor Graff, director of the Industrial Art School, Dresden.

The Industrial Art School, Dresden.—The Director, Professor Graff, only admits advanced students, and declines to teach elementary work, for which there are many other schools in the city. The number of students is therefore comparatively small, being 106 in winter and 96 in summer. In addition to these, there are from 70 to 80 who attend only in the evenings. The State provides 16 bursaries for poor students, who have gratuitous instruction, and grants for maintenance during their attendance at school.

Training of Director.

Professor Graff has had the advantage of a varied literary, scientific, and artistic training. He attended the University and the Polytechnic school, and afterwards went through a course of study in the Academy of Arts of Berlin. He is a professional

designer for metal work, porcelain, furniture, and cabinet wares, textiles, wall papers, &c., so that he combines a knowledge of pure art with its practical applications.

No trade work carried on in the school.

Contrary to many of the authorities with whom we conversed, he does not favour the introduction of workshops into the school, and we did not see the application of any of the practical designs to industries in his school. His view is that the school should do its own work, which is to teach design, and should not trench on the workshop. Once begin to make the object designed, in the school, and the character of the school is changed. Certain applied arts, such as goldsmiths' work, metal chasing, ivory carving, &c., may be carried on in schools of this character, but the elaborate execution of textiles, colour printing, furniture, pottery, cast and wrought-iron, stone work, &c., cannot be introduced without expensive machinery and extensive space. We state this opinion without adopting it; the examples of Nuremberg, Munich, and Vienna, tell altogether on the other side of the question.

Professor Graff said that his instruction was not of so circumscribed a character as that of some of the best French schools, where the teaching of design is not carried to the stage to which it is in the Dresden school; the principles of design only being taught in the former without reference to the material in which the designs will have to be executed. He claims that few, if any, schools in Germany, are supplying to the various industries so many complete designs for high-class work as that of Dresden.

System of teaching.

In comparing the Kunstgewerbe school of Dresden with those, say, of Munich, Nuremberg, and Vienna, Professor Graff explained that, while the latter teach the students to design, and in several of their departments to work out their designs in materials ready for the market; in the Dresden schoo the design only is made, and the application of the design to the material in which it is to be executed is left entirely for the workshop or factory.

Foundation of new art industries.

New industries have been started entirely through the influence of this school, decaying ones have been revived, his pupils are to be found in superior positions in many of the leading works in Saxony. He conducted us to a shop in the town where we were shown an extensive assortment of brass, bronze, leather work, and various articles, peculiar, as we had thought before, to Paris and Vienna, the designs for which had been supplied by the school. Formerly all the lace designs used by the large and small manufacturers in Saxony came from Paris or Belgium. Most of the designs are now, according to Professor Graff's account, supplied by this school, or by students who have gone through its classes. Trimmings for apparel, &c., are also designed, and a large furniture-making

establishment in the town, like some of the other manufactories, receives its designs from the school.

Designs made for sale.

The pupils are usually able to draw fairly well when they come to the school, and they take up practical designing as early as possible, with a view to earning a livelihood. Not unfrequently as much as 4*l.* or 5*l.* is obtained by the pupils for a pattern. Some of the students take advantage of the assistance of their teachers in selling the designs they make, rather than accept situations in which their scope of action would be limited, and their opportunities of further tuition cut off. The director's room was a museum of designs for a great variety of purposes. He showed us patterns for lace, textiles, pattern cards, ornamental Christmas, birthday, and menu cards, designs for porcelain, bronze, brass, and goldsmiths' work, all either sold or made for sale, and either the work of students, or of students and teachers combined.

Conversation with Professor E. Ewald, director of the Kunstschule, Berlin.

Berlin Royal School of Art.—Professor Ewald informed the Commissioners that the Art and Industrial Museum, to which the school is attached, was founded by a private society, and is now supported by the State. The institution has been assiduously promoted by the Crown Princess of Germany, who has striven to make it like the museum at South Kensington. In some departments this museum was fully up to the standard of South Kensington, both as to quality and quantity, notably in pottery and glass, and probably also in metal work.

Berlin and South Kensington compared.

There is one striking difference between this school and that of South Kensington (which latter Professor Ewald has carefully studied). The Berlin school has no provincial schools connected with it as South Kensington has. He is of opinion that the English art system, with its great central school at South Kensington, training and sending out teachers, examining works, supplying copies, art examples, and advice, to the provincial schools, is an admirable organisation, and much before anything of the kind in Germany. He referred in flattering terms to the artistic progress made by England since the South Kensington system has been started; and, bearing in mind the low position of industrial art in England 30 years ago, he thinks that no country in Europe has made such marked advances. Germany has, in his opinion, much to learn from England.

Professor Ewald on methods of teaching applied art.

As to methods of study, his opinion coincided with that of many other professors. In the training of a designer, the most important task of the teacher is to ingraft in the student's mind a knowledge and love of pure art, which forms the basis of all applied art. Teach drawing, or art pure and simple, in the first instance, without heeding the predilections of the student, because, the more thoroughly students are grounded in the knowledge of form, colour, &c., the more proficiently will they be able to turn their knowledge to useful account afterwards, and the less likely will they be to be led astray when

they have to apply artistic principles to industrial purposes. For workers in wood, stone, and the decorative arts, it is impossible to attach too great an importance to modelling. The school has trained many successful designers, who are distributed over a number of manufactories in the city and in other places, and designs made by students attending the school are often sold to manufacturers. As to the separation of the school from the workshop, Professor Ewald was of opinion that, where art manufactures are in an advanced state, the application of art industry may safely be left to the workshop. Given your artistic student, whether intended for a designer or a workman, the workshop will give him all the opportunities necessary for the exercise of his knowledge, and he will find new ideas and inspiration from sources of his own selection, and apply them in his own way; but, where taste is low, and manufactures undeveloped, he thinks it justifiable for the State not only to teach art, but also its application to manufactures. The first object of all who are interested in the higher culture of Prussia is to stimulate taste. It needs to be very extensively cultivated, not by the manufacturers only, but also by the public, and therefore, although he would prefer to leave the applications of design and art workmanship to the workshops themselves, he would for the present adopt a different course, teach drawing in all schools, carry it forward to as advanced a stage as possible in the direction of designing, and would then apply it, as at Munich and Nuremberg, to the actual work to be done.

Relation of school to workshop training should differ in different countries.

The professor spoke of art education generally, as having been at a low ebb in Berlin. It had not received anything like due attention in the past. While scientific and general education had been extensively and enthusiastically promoted, art education had been neglected. The consequence was what might have been expected. In such works as require artistic design, the important posts had been held by foreigners, or the industries had languished. People then began to say that the Prussians were devoid of artistic sentiment; they had no taste. His opinion was that they had not been artistic because they had not studied art. They had not been charged with being unscientific, because such a charge could not be made. And why? Because they had studied science. The past neglect of art instruction in Berlin had undoubtedly affected adversely the local industries. When asked, how about calico printing, the professor replied, "Calico printing is dead in Berlin. It has gone to Alsace."

Art Education in Berlin.

Instruction of the Apprentices at the Royal Porcelain Factory, Charlottenberg, Berlin.—In going over the Royal Porcelain Factory, the director expressed his views on the teaching of art to apprentices. The method adopted at the royal porcelain works at Sèvres is to have a school for apprentices within the works, where the teaching is specialised and made as technical as possible in its character. The apprentices at Charlottenberg, of

Mr. Sussmann Heilbron.

whom there are 20, do not receive lessons in drawing in the works, but attend the classes at the Kunstschule in Berlin. Their fees are paid out of the funds of the works, and the course of their instruction is arranged by the director of the works and the director of the school. They do not all attend at the same time, some go by day, others in the evening, and some attend the Sunday classes, the times being arranged so as to suit the convenience and abilities of the apprentices. It is mainly pure art that is taught, but also the application of the same to the modelling and painting of porcelain.

Comparison of the method of teaching at Sèvres and at Berlin.

The director considers that the students receive a valuable training at the school, which materially helps them at their work. Although apprentices are selected because of their taste and superior knowledge of drawing and modelling, their art education only seriously begins when their inventiveness in design and workmanship is tested by its money value upon the objects produced. It is then that their faculties and enthusiasm become quickened, and power and motive are given to their efforts. If the 20 apprentices were taught at the works, masters of varied requirements and abilities would be necessary, and their employment would largely increase the expenditure upon the works. He therefore considered that school teaching was much more economical and also much more effective than teaching within the works. He would prefer to send his apprentices to the Kunstschule for their art instruction, rather than adopt the Sèvres method of teaching it within the works.

Kunstgewerbe School, Vienna. Conversations with Professors R. M. Belf (director), Herdtle, Storck, Klotz, &c.

Industrial Art School, Vienna.—As will be seen from the description (p. 163), this is one of the most important of the industrial art schools visited by the Commissioners, and we had interesting conversations with the professors. The system of teaching is similar to that of Munich and Nuremberg, the application of the design to the material being in several departments practically carried out in the class rooms.

Lace designing.

In the department for lace, we found a number of young women engaged in designing Venetian point lace, taking ideas from lace patterns and photographs before them, of which the collection is very extensive. On this question of lace designing and lace making we received some interesting information.

A decaying lace industry revived.

In some of the remote districts of Austria, in the Erz-Gebirge, far away from the manufacturing centres, large numbers of the population, not less than 20,000 women and girls, obtain their livelihood by lace-making. At one time the lace made by these country people was much esteemed; it was considered tasteful in pattern, well made, and commanded a high price. In course of time the fashion changed, foreign competitors introduced more novel or cheaper designs, and undersold the original makers. The poor peasants were not able to understand the cause of the decline in their industry, and went on making lace that was not wanted, until many of them were reduced to positive

starvation. The unfortunate condition of these poor starving peasants seemed to justify State interference. The matter was investigated, and resulted in the establishment of this lace department in the Kunstgewerbe School, in which a number of girls (brought annually from the country districts) are trained for three months in the art of designing, and also in the most modern and advanced methods of lace-making. After going through an efficient course of instruction, they return home, and teach their neighbours the arts which they have learned at the Vienna school, with this important result, that there has been great improvement in lace-designing and in lace making, with a return of comparative prosperity to the suffering peasantry.

Success of school.

As to the general success of this art school, we gathered from the several professors that they are not by any means satisfied with the public interest in their work. The school is not supported, as they think it ought to be, by the manufacturers engaged in the very industries whose success it has been the main object of the school to promote. Instead of the attendance of large numbers of apprentices from manufacturing works in and around Vienna, very few come to the classes, and the bulk of the students are being trained, not as designers or art workmen, but as teachers in other schools, mainly in provincial towns. They did not consider that the school exerts any really powerful influence upon the industries of Austria and Vienna, because the promoters of the industries do not encourage it in any way. The Austrians seem to believe that there is no designing like that of Paris, and the manufacturers spend large sums on French designs, instead of helping the designing faculties of their own people, which, in the opinion of the professors, are as strong as those of the French.

Activity of State aided schools.

We took note of those opinions rather as the expressions of men in great earnest in their work, than as describing the real condition of the school, which, in every department, impressed us favourably. It is often said that State support tends to carelessness as to results on the part of the recipients of State pay. This certainly cannot be said to apply to the professors of the Industrial Art School of Vienna, nor indeed to any of the Kunstgewerbe schools which we visited.

Foreign opinions on art teaching on the Continent.

Opinions respecting art teaching.—Whilst on the Continent, we heard many flattering opinions as to the vast importance of certain technical and art schools that we visited. Some of these opinions we have inserted in this Report. We also received opinions and evidence of a more critical character, which we have no desire to ignore. One gentleman, of large experience and knowledge, warned the Commissioners against recommending the too extensive establishment of high art schools on the Continental model. Referring to the Antwerp Academy of Fine Arts, with which he was very familiar, he said that much

Danger of free State supported art schools.

greater care should be exercised in England than at Antwerp as to the admission of students. It is quite a mistake to open the door to all who wish to enter, when no charge is made for the teaching. These academies are excellent institutions if kept to their right use; they bring deserving and talented students to the surface, and benefit the State as well as the students; but a very careful discrimination should be exercised over the admission of students, or the public funds may be wasted upon incompetent and unworthy recipients. Every sentimental youth believes himself to be a born artist, or, what is quite as bad, his father and mother think him so, and, seeing the success of some really talented student, they fondly hope for and expect the same from their son, and they send him to an Academy to become a painter. Why should they not send him? The tuition costs nothing, and it sounds well to be able to speak of a son who is studying at the Academy, and it is flattering to hear the high praise of neighbours who are called in to see and admire the drawings he has sent home. The youth severely drains the slender resources of his parents while for three or four years he goes through the courses at the Academy, and encounters the more serious temptations which all large towns offer to young men who are removed from parental control and influence. The young man may be destitute of talent, or lacking in the equally important quality of perseverance, and returns to his home, expecting the world to bow at his feet, and give him his own price for the third-rate productions which he has to sell. The self-styled artist, conceited from the beginning, naturally becomes discontented, and may afterwards be found (as our friend has found many) with his coat out at elbows, unable to earn a living; a wretched professional artist, without imagination or designing faculty, pushing indifferent pictures upon an overstocked market. When a peasant's son paints "Andromeda chained to the rock," or "Ajax defying the lightning," he often assumes airs altogether imcompatible with his position or his possibilities. Very few of these free students ever become artists of merit, still fewer really good industrial designers, but they often get into an extravagant way of living, without possessing the means to justify such habits, and they grow up into a class of men of far less use to the world than if they had remained hewers of wood and drawers of water in their own villages. Above all, avoid encouraging the idea that it is the schools which make the artists, designers, and engineers, and that, given the schools, great artists will spread themselves over the land. There can be no greater mistake. Belgium and Holland produced their best artists without schools, Holland its best engineers without schools, and what schools did the great inventors of England attend? The work of life puts into the shade the teaching of the professors. If you are too liberal in opening the highest schools to the public, without such safeguard as a proper entrance examination, you draw

mediocrity into them, and run a great risk of wasting your teaching on students who, whatever other qualities they possess, were never intended for artists. The free art schools are a constant temptation to the stripling, whose great ambition is to become a "Monsieur" without working for the title; he goes there and fails to produce anything that anybody will buy. There is no happiness for such a man, he had better have remained a house painter at home. In studying Continental art schools, it is desirable to reckon up their cost and compare it with the results. Education has to be paid for by somebody, and in those cases in which the payment is made entirely by the public, there should be a reasonable assurance that the public will be benefited. The great art schools of France and Belgium are admirable institutions, but, as examples for England, they present features to be avoided as well as to be imitated.

National characteristics of French and English.

One gentleman remarked that, from his large experience of foreign nations, he had come to the conclusion that race and blood have great influence upon the handicrafts of a nation. The French are more elegant than the English, altogether apart from education. Their climate is milder and more sunny, gaiety is natural to them, and, living much more in the open air than the English, their natural tastes are more susceptible of development. The French designs are characterized by greater elegance. In Paris the designers are surrounded by examples and aids to inspiration such as cannot be found elsewhere. Paris, to use a commercial term, may be called "the exchange" for designers from all parts of Europe, and it is the principal market for designs. The drawing of the Parisians is generally of a decorative character, and in freedom of outline they excel all other countries.

French and English silks and designs.

On the fancy textiles of England and France, and the aptitude of French workmen, the following is the substance of opinions expressed. The productions of Lyons are now universally acknowledged to be in advance of those of Coventry and the other silk manufacturing towns of England. The workman of Lyons, who, as a matter of fact, lives in the same attic with his loom, is always making patterns. He spends his days from childhood to old age over patterns, and the last pattern in the loom is the household topic till the web is woven. As the loom is seldom allowed to be idle, both the wife and children are taught to weave each new pattern as it comes. While the husband eats his dinner, the wife takes her turn at the loom, and the children take their turns also while the father takes his rest and the mother goes about her domestic employment. So all day long the busy shuttle is kept going, and patterns and designs are ever before the physical and mental vision of the Lyons weaver. The day may come when England will overtake Lyons, but how can she hope, by the establishment of a few schools, to equal

[illegible] have done for the Frenchman. It is in the opinion of our informant no more reasonable to expect the English to surpass the French in artistic work as designing and decorative operations than it would be to expect the French to equal the English in mechanical ingenuity, and in the great engineering operations which have so largely contributed to the industrial supremacy of England.

PART II.

VISITS TO INDUSTRIAL ESTABLISHMENTS ON THE CONTINENT AND CONVERSATIONS WITH EMPLOYERS, MANAGERS, AND WORKPEOPLE.

In addition to the inspection of technical and other educational institutions, your Commissioners took advantage of every opportunity of obtaining evidence and information relating to the practical effect of these institutions upon the industries intended to be benefited by them. Incidentally we received information as to rates of wages and hours of labour, the influence of piece-work, division of labour, protective duties, the military systems, and other conditions which, in each Continental State, more or less affect the cost of production and the quality of the manufactures. In every country we were, almost without exception, courteously admitted to the leading industrial establishments, and in many instances the fullest opportunities were afforded to us of inspecting the processes of manufacture in detail. Employers, managers, and workmen, favoured us with their opinions upon industrial and educational questions. In the following descriptions, while on the one hand we have avoided the disclosure of what may be termed "trade secrets," we have on the other endeavoured to convey a general impression of the leading industries abroad, and have impartially recorded the opinions of representative men of all classes, on the various matters of interest to the commercial and industrial classes of our own and other countries.

COTTON SPINNING AND WEAVING, FRANCE.

Cotton factories in France.

The Commissioners visited cotton factories at Rouen and Lille, and had conversations with representative men engaged in the cotton industry, amongst others with M. Pouyer Quertier, who was Finance Minister during the presidency of M. Thiers, and who is the leader of the protectionist party in France. We were informed that since the annexation of Alsace by Germany, nearly all the cotton machinery used in France has been imported from England, and is subject to a duty on entering. The French protectionists, who have laboured strenuously for upholding duties on all imported cotton yarns and goods, regret that, by the transference to Germany of Alsace, which was the seat of the cotton-machine making industry of France, they must now pay a duty on all Alsatian machinery. England, having been placed on the same level as Alsace, has undoubtedly profited by this change.

Influence of Technical Schools.

As in other countries, we did not receive any evidence that, in France, technical schools have been of any direct advantage to foremen or workmen engaged in spinning and weaving. Many admitted that a theoretical knowledge of the cotton fibre, its growth structure, and properties, should be possessed by all engaged in its manipulation; that the machinery, and all the calculations connected therewith, should be studied theoretically; and that a knowledge of design and of the loom should be taught to all foremen and masters. At present, this teaching is not attempted in any schools in France; but favourable reports were given of the spinning department of the weaving school at Mulhouse (see p. 128), with which some gentlemen with whom we conversed were acquainted. In general, an opinion was expressed that the only real education for the cotton spinner is that which he obtains in the factory. Nevertheless, it was universally thought that it is different in the case of the calico-printer. Manufacturers of calicoes for printing can only live by the attractiveness of the finished goods. However perfect or cheap, their profitable sale depends almost entirely upon the skill and taste of the colourist and printer who fix the designs upon the cloth; and, therefore, it was argued, the cotton industry depends as much for its success upon schools of design and practical chemistry as if every manufacturer had to sell his goods in the finished state ready for the shop counter.

Hours of labour in French cotton factories.

We found that the hours worked in French cotton factories are by no means uniform, as they are in England. In Rouen, which is the chief seat of the cotton industry of France, the rule is for factories to run 12 hours per day for six days in the week, but, at one factory which we visited, the engines were being kept continuously running for 14 hours each day, with a break of 10 minutes for oiling, or a total of 83 hours per week. On inquiry, we ascertained that the workpeople at this factory came at five o'clock in the morning in summer, and remained on the premises until seven at night, and in winter from six o'clock until eight at night; but they did not work more than 12 hours a day each. The work is so organised that one in six of the hands may be always away at meals, thus allowing two hours for each during the day. It was very apparent, however, that most of the meals were taken in the workrooms, for we saw dining operations of a primitive character going on behind the machines in nearly every room, and we met children in the staircases and passages bringing dinners for the older people. Not a few energetic "piecers" walked about the "gates" with pieces of bread and meat in their hands, which they placed on the machine or pocketed when both hands were required for "piecing." The question was asked of an employer whose factory worked till eight at night, "Do your operatives "drink much?" He shrugged his shoulders characteristically, and replied, with a smile, "Ah! no; they do not drink *much*. "You see, they have not time, and they have not money."

Employment of children.

The proportion of children employed in factories in France is smaller than in England. They are not admitted until the age of

12, and for three years they are said to attend school two hours a day. Many of the schools are connected with the factories, but we were not favourably impressed with the education and discipline of such as we saw.

Wages. Wages are paid fortnightly, and by piece. In the carding and preparing operations women are paid from 1*s.* 6*d.* to 1*s.* 9*d.* per day; children, from 10*d.* to 1*s.* 2*d.* Spinners (men), from 3*s.* 9*d.* to 4*s.* 9*d.* per day; piecers, from 2*s.* 3*d.* to 2*s.* 6*d.*; boys, from 10*d.* to 1*s.* 2*d.* Throstle spinners (women), about 2*s.* 3*d.* per day, maximum. Reelers (by hand) and warpers, about 2*s.*; and weavers, from 2*s.* to 2*s.* 6*d.* per day; men earn, in many instances, a higher sum. Mechanics are paid by day, from 4*s.* to 4*s.* 6*d.* The rates of wages paid, and the earnings, vary considerably in the different factories. We generally found that the rates per hour or per piece were lowest, and the earnings highest, in the most modern factories.

Coal. At Rouen, much of the engine-coal comes from Cardiff. In one instance an inferior slack was said to cost 14*s.* 6*d.* per ton delivered at the boiler; it was raising steam at the rate of 1½ kilos. per horse-power.

Reliance on protection. Without describing in detail any of the factories we visited, we may remark that some were furnished with the newest and best of English machinery, and organised on the pattern of the foremost mills in Lancashire, while others were evidently relying more upon protection, coupled with long hours and low wages, than upon efficient machinery and enterprise.

Mechanics' shops in factories. We noted that the mechanics' shops of French factories are invariably larger, in proportion to the machinery employed, than in England. This is not surprising when it is remembered that all the important machinery comes from England or from Alsace, and has to be subjected to the delay of transit and custom-house interference, so that they are compelled to have many duplicates or parts of machines always in stock, and, indeed, many small machines are made on the premises. In one of the factories that we visited of less than 60,000 spindles, there were about 20 mechanics employed, with a proportionate amount of stores, and a number of machine tools, more or less antiquated. We ascertained that these mechanics were the highest paid artisans on the premises. In comparison with this, we may mention a cotton factory in Oldham of 70,000 spindles, visited by one of the Commissioners, where not a single mechanic was employed. Each overlooker could use hammer and file and chisel, and, in small matters, the engineer of the factory acted as a mechanic. When repairs were needed, mechanics were at once sent for from Messrs. Platt's machine shop in the same town, and, without loss of time, breakages were made good, or new portions of machines supplied. In a French factory, the distance from a machine shop necessitates the employment in the factory of an ample staff of mechanics, and their wages and the cost of the material they use must be reckoned in the cost of the yarn produced, along with the wages of the spinners and carders.

Wool Industry, France.

Wool industry, France.

When considered in relation to its competition with England, the wool industry of France is specially important. We visited the growing towns of Rheims and Roubaix, which compete so largely with the Bradford district in the manufacture of dress goods for ladies' wear.

At Rheims, through the kindness of Mr. Jonathan Holden, we were introduced to the leading manufacturers and merchants of the town, who generously admitted us to their works, and gave us the fullest information. Mr. J. Holden also accompanied us in our tour of the schools, and conducted us over his wool-combing establishment, a very extensive shed, furnished with splendid engines and machinery from England.

Professional School and classes under the Industrial Society, Rheims.

We have elsewhere described the excellent Professional School of Rheims, which is one of the most efficient of the Technical Schools of France, and the evening classes of the Industrial Society, for instruction in drawing, book-keeping, literary subjects, languages, and the theory of weaving, attended mainly by artisans. At Roubaix we saw the temporary premises of the Weaving and Dyeing School; and the scheme of the projected new school, which will shortly be commenced at a cost of over 80,000*l.*, was described to us. In the town of Lille there is a large and important school with departments for designing, weaving, and dyeing, and in the smaller manufacturing centres there are technical schools specially organised for supplying theoretical knowledge applicable to the local industries. Of the influence of these schools we shall endeavour to give some evidence in recording our conversations with the industrial representatives themselves.

Report by M. Koechlin Schwartz in 1878.

In an interesting report on the wool industry of France by M. Koechlin Schwartz, one of the jurors of the International Exhibition of Paris in 1878, it is stated that in 1851 the number of spindles in France for combed wool was 850,000, including Alsace. In 1878 the number reached 2,270,000, not including 200,000 in Alsace.* These spindles are estimated to produce 34,050,000 kilos. (74,910,000 lbs.) of yarn a year. The value of the goods from combed wools manufactured in France in 1878 amounted to 564,075,123 francs (22,563,000*l.*), upon which the amount paid in wages is calculated to have been 147,632,134 francs (5,905,000*l.*). The report further states that so great have been the mechanical improvements during recent years, that, since 1867, the cost of wool-combing has fallen 25 per cent.; that since 1851 the cost of spinning has decreased more than half, while during the same period the wages of spinners and piecers have

* From a Parliamentary Return dated July 1879 it appears that the number of spindles in the worsted factories of the United Kingdom was at that time 2,096,820.

increased 40 per cent. The improvement has extended in a still greater degree to weaving. In 1851 nearly all weaving was done by hand, and the weaver was paid 1·75 francs to 2 francs as wages for a day of 12 hours. In 1878 there had been an enormous extension in power-loom weaving, the weaver tending two looms, at wages averaging from 4 francs to 4·25 francs per day. "In 1851 the goods were irregular and imperfect, while "in 1878 they have almost attained perfection with half the "manipulation and double the wages paid to the workman." The remarkable advance here indicated appears to have been continued from 1878 to 1883, hand-looms have been still further replaced by power-looms, until there are now comparatively few hand-looms remaining, and in the meantime the wages have not diminished.

Wages at Roubaix.

In Roubaix the wages of ordinary drawers on the "rubber" principle are from 12*s.* to 14*s.* per week of 72 hours, according to the machinery they mind. The mule spinners (usually by piece) earn from 22*s.* to 25*s.* per week, piecers from 15*s.* to 16*s.*, boys from 7*s.* to 12*s.* In some exceptional instances, where cap frames are employed, the spinners are paid by the day, at the rate of from 12*s.* to 14*s.* per week, doffers about 7*s.* 6*d.* a week. Weavers, by piece, for two looms, earn from 18*s.* to 28*s.*, one-loom weavers from 13*s.* to 16*s.* per week of 72 hours.

Hours at Roubaix.

The division of the hours for the day's labour will show the small amount of leisure enjoyed by the operatives in French worsted factories as compared with those of England. The hours are 72 per week, beginning each morning at six, allowing two hours for meals, and closing work at 8.30 at night for four nights, making 12½ hours per day, so as to allow for stopping work at 6 o'clock on Monday night and at 7.30 on Saturday.

(The hours are 56½ per week in English factories, which close at 5.30 in the evening, excepting on Saturdays, when they cease working at one o'clock.)

Comparison of worsted industry in France and England.

Comparing the worsted industry of France with that of England, it must be remembered that in the past there has been no general competition on the same lines between the two countries. Although there have been manufacturers in Bradford who have extensively made the same classes of all-wool goods as their rivals in Rheims and Roubaix, and manufacturers in these latter towns who have made lustre—and mixed—goods similar to those of Bradford, yet, broadly speaking, the fine all-wool goods for a generation past have been a speciality of France, and the lustre—and mixed—goods have been chiefly made in England. The spinning machinery employed in the two countries has been entirely different, as we have explained in our notes on Loth, Belgium, and Alsace. The mule process of spinning has been adopted on the Continent generally, while in England, for spinning similar wools, the cap and flyer frames have been almost universally used. About fifty years ago there was direct

competition between Bradford and France in the making of French merinos and other fine soft dress goods, and mule spinning at that time was not uncommon in Bradford. But about the year 1840 the alpacas and bright goods, and the mixed fabrics with cotton warps, were introduced as a new trade into Bradford, and the manufacturers took it up with great enterprise to the neglect of the finer branch of the trade, which was still continued by a few manufacturers, but in the great bulk was given over to the French. For many years both industries in both countries flourished, and, so far as the outward evidences of prosperity are concerned, the visitor to the rival towns in France and England would not hesitate in giving the palm to the latter. It may therefore be concluded that, if Bradford in some degree deserted the more important branch of the trade, the result for many years justified the change. It was seen by many, however, that in the nature of things the manufacturers of fine wools were in a more favourable position than those who depended upon the long lustrous wools grown in our own country, because the fine wools were not only intrinsically better, but the prospects of supply were practically unlimited, while the growth of the lustrous wools was in a great measure circumscribed within the narrow boundaries of this island. In 1810 the first parcel of 167 lbs. of Australian wool was received in this country; in 1860 the import was 59,000,000 lbs.; in 1882 it reached 345,000,000 lbs., while during the same year there was an additional import of 144,000,000 lbs. from other sources. The French manufacturers were, by the previous course of their trade, and especially by the machinery which they employed, better prepared than those of England for dealing with this valuable and ever increasing raw material; their acquired skill in manipulation, their cultivated taste, and their greater excellence in dyeing, materially assisted them in making the most of their advantages. The abnormal prosperity of 1871–2, after the close of the Franco-German war, encouraged a further development of the manufacture of the lustrous goods in England, but beginning about 1875, the demand for these began to decline, and the consequent over-production, together with bad harvests, hostile tariffs, and the increasing inclination of fashion in favour of soft all-wool fabrics, brought about a great depression in the long-wool industry in England, while the same change increased the prosperity of the rival manufacturers in other countries.

Australian wool.

Cause of the English depression in the woollen trade.

These facts were, however, for some time overlooked, and the depression in England was attributed to two causes; viz., the greater cheapness of labour in competing countries, as represented by longer hours and lower wages, and the superior technical education of our foreign rivals. As a matter of fact, the labour question had very little to do with the depression.

There were, however, manufacturers in Bradford who already made the soft goods, and others who adapted their machinery so

as to make them, and, in spite of higher wages and shorter hours, they managed to keep their machinery running without loss side by side with their French rivals. On the other hand, the manufacturers of lustrous goods in France and other countries, found it impossible—not simply to make a profit—but to avoid making a loss in spite of their advantages in labour and wages. In the manufacture of fancy goods the French and German manufacturers—particularly, the latter—greatly surpassed those of England, thanks, apparently, to greater technical knowledge, and especially of dyeing; the care displayed by the operative dyers being undoubtedly greater than could be found as a rule among the representatives and operatives of dyeing establishments in England.

State of woollen trade in the interval between 1881 and 1884.

The Commissioners visited the North of France in 1881 and 1884, and during the interval the fashions have still favoured the fine all-wool goods, but there has been a great development in the manufacture of these goods in England. The severe depression in this country brought with it a necessary lowering of wages from the inflated period of 1872, and also a reduced expenditure in manufacturing establishments. The adaptation of machinery to the change in the trade has received the ceaseless consideration of the most enterprising and practical manufacturers, supported by the machine makers themselves. Some firms in England have adopted the French system of mule spinning, with all the improvements that could be suggested by mechanical knowledge and experience, while many others have directed their attention to the adaptation of the existing principle of preparing and cap spinning to the requirements of the finest and the shortest stapled wool. The dyers have put forth their energies in the enterprise. The Technical College of Bradford has been equipped with departments, qualified professors, and the best obtainable apparatus and machinery for designing, weaving, and dyeing. Beyond all these agencies there has been the hearty co-operation of all classes of artisans and factory workers in the trade, and their combined effort has had the result that British all-wool goods of several varieties are taking their stand in our own and other countries in open competition with those French and German goods which, but three years ago, seemed to enjoy almost á monopoly of public favour, so that Bradford manufacturers at the present time (March 1884) are as well and as profitably employed as their rivals in any country.

Hopeful feeling with reference to French woollen trade.

In conversations with spinners, manufacturers, and merchants, in Roubaix and Rheims, there was a strong feeling of hopefulness expressed with regard to the future of the French wool industry. In the beginning of the year 1883 there was a great falling off in orders at a time when it was found that their rivals in Bradford were exceptionally busy, and it was feared that the competition of Bradford was becoming more serious than had been anticipated; but towards the autumn, the trade began to

revive again, and the manufacturers entered upon the year 1884 with fair business and prospects.*

German competition in the fancy woollen trade.

One of the large merchants of Roubaix, speaking of the fancy trade, said that it was being ruined by German competition. The Germans produced more novelties in design, they did better work, and had taken more pains than the local manufacturers As to designs, very few were produced at Roubaix, or, if produced there, were the work of Parisians who after a few years, were worked out, and needed to go back to Paris again. "The air and the surroundings of Roubaix did not "particularly favour artistic sentiment." Another merchant confirmed the statement that the fancy trade had gone to Germany. He said that a few years ago there were 300 manufacturers in the district, and that now there are not more than 200. The difference arose from the fancy manufacturers, employing handlooms, having been compelled to give up. This degeneracy in the fancy trade had roused the authorities into action with regard to the technical school, and not too soon. Its main purpose would be to help to bring back the fancy trade. It would be heartily welcomed by all classes, and the operatives would be the last to complain of the cost, however much it might be. The same gentleman was of opinion that the dyeing of all-wool goods in France has long been superior to that of England, but they are not by any means satisfied with their local dyeing, and goods of delicate shade are often sent to Paris to be dyed. Some of the leading dyers have been highly educated in science, but the workmen, as a rule, have but little, if any, chemical knowledge.

German competition chiefly feared at Roubaix.

In the dyeing of mixed goods, with cotton warp, the French merchants are willing to admit the superiority of English dyers. With an extensive knowledge of the trade both in French and English markets, he has seen no recent evidence, from such goods as he has come in contact with, that Roubaix is likely to be surpassed by Bradford. He expressed himself, however, as seriously alarmed by the growing competition of Germany.

M. Delattre.

M. Carlos Delattre is one of the chief promoters of education in Roubaix, and is also a member of the Commission appointed by the mayor to report upon the wants of the town in respect of technical instruction. He conducted us over the temporary weaving and dyeing school, which is attended by about 80 students. The evening classes, for whose accommodation the

* The question of the competition between France and England is one of vital interest to the Yorkshire trade, and therefore the following additional remark on the subject may not be out of place. It was affirmed by one spinner whose factory we inspected, and who had imported from England the most recent adaptations of English short nip drawing and cap frames, and was competin, against mule spinning in its stronghold, that, from the shortest wool, he could make a yarn which manufacturers preferred to a yarn from the same wool spun on the mule. In conversing with this gentleman on the question of cap, versus mule, spinning, he held that the difficulty in cap spinning was not in the machinery, but in the organisation of the labour.

new technical school is to be built, are held in various quarters of the town, and are attended by a total of 600 students. The total annual grant for their maintenance is 2,220*l.*, of which 720*l.* is contributed by the State.

Projected new technical school at Roubaix.

The plans for the new school are now prepared, and the excavations will shortly be commenced. The cost will be at least 80,000*l.*, towards which 48,000*l.* will be contributed by the Government, through the Department of Fine Arts, and 32,000*l.* by the municipality. It is expected that the annual cost of maintenance will not be less than 3,200*l.*

School will be mainly for pure design.

The school will be devoted chiefly to pure art and designing, but there will also be departments for mechanics and physics, a lecture hall, public library, and a museum of textiles, which is intended to be specially useful as a trade museum. The departments for weaving and dyeing will be accommodated in a separate building, and will contain an equipment of looms and other apparatus fully equal to those of any school yet established.

Applied design.

Designing will be applied to such articles as wearing apparel, decorative cloths for "furnitures," carpets, upholstery, &c.

It is believed that "high design" may be successfully taught at Roubaix, and that in improving the fancy textiles the influence of the "Administration des Beaux Arts" will be as beneficial there as it has been in the case of the Beauvais and Gobelin tapestries.

Progress made in recent years in dyeing.

M. Delattre informed us that during the ten years that the technical weaving and dyeing school has been in operation, great progress has been made in the dyeing industry. In every establishment where sons of employers, foremen, and workmen, have attended the classes, good results have followed. In the dye-works many of the young men can make their own preparations. There is less need of supervision; economy of production has in many instances followed attendance at school; fewer mistakes have been made, and more reliable and more efficient work has been done.

Conditioning House, Roubaix.

Conditioning house, Roubaix.

The conditioning house of Roubaix, like the similar establishments of Lyons and Crefeld, undertakes the testing of all raw materials and manufactured goods, with regard to actual weight, measurement, and condition. Certain standards of condition are recognised in various materials, upon which allowances are made for the moisture which they contain. For example, in conditioning raw wool a given weight is placed in a receiver, through which there passes a current of hot air at a temperature of from 105° to 115° Centigrade. After remaining here for about an hour, the wool is carefully weighed, and

14 per cent. is added to the weight to allow for its having been artificially dried, and to restore it to its natural atmospheric condition. Upon tops, after being artificially dried, an allowance of 18¼ per cent. is made; upon wool yarns, 17 per cent.; cotton yarns, 8½ per cent.; silk, 11 per cent.

Cost of conditioning spun wool.

The cost of conditioning tops is reckoned on the bulk from which samples are taken, and is about 10 francs per 1,000 kilos (about one twenty-third of a penny per pound).

The house was built by the town at a cost of 16,000*l.* It communicates with the railway by a siding, so as to facilitate the arrival and transport of products to be tested. In 1883 the profits, after paying expenses, amounted to 8,000*l.*, which were entered in the municipal receipts and appropriated to ordinary municipal objects.

Extent of the work carried on.

A conception of the magnitude of the work carried on may be gathered from the following figures relating to the wool, tops, yarn, &c., conditioned:—

	Kilos.
In 1858 - -	84,268
„ 1860 - -	1,998,159
„ 1869 - -	11,653,156
„ 1871 - -	14,093,867
„ 1882 - -	19,425,434

The test is optional.

The conditioning is entirely optional; if buyer and seller agree to any transaction without submitting to the official test and the necessary expense, they can do so; but, as almost invariably happens, either buyer or seller wishes to know *what* he buys or sells, the goods are tested, and in case of dispute both parties are bound to accept the official decision.

Importance of the test to both buyer and seller.

In conversing on this subject, complaints were made by manufacturers that English yarns when they come to Roubaix are not conditioned, nor tested as to length, and that the English spinners will not submit to the Roubaix test. One gentleman stated that he had been subjected to so much annoyance in consequence of English yarns not coming up to the standard, that he never buys them when he can get similar yarns elsewhere. He agreed that everybody took advantage of yarns that were known *not* to be certified. If, for instance, he sent English yarn to a dyer, and deficient weight was returned, all the blame was thrown upon the spinner, the dyer knowing that no certificate of weight had accompanied the yarn. In sending English yarn to hand-loom weavers, he calculated the necessary weight and counts for certain lengths of cloth. Frequently short lengths were returned, and the weaver would invariably throw all the responsibility upon the spinner, knowing there was no proof to the contrary. With French and German yarns this was impossible, and therefore the manufacturer argued that a conditioning and reeling test protected the seller as much as the buyer, and removed the temptations to dishonesty which exist under the English system.

Wool-combing Establishments of Messrs. Isaac Holden and Sons, in France.

Among the most extensive and remarkable of the industrial establishments of the Continent are the wool-combing works of Messrs. Isaac Holden and Sons, at Rheims, and at Croix, near Roubaix. Similar works belonging to this firm are situated at Bradford in Yorkshire, and the three branches are employed in the combing of fine merino wools for dress goods and knitting purposes. They do not purchase or comb any wools on their own account; they simply comb "on commission," at specified rates, such wools as are sent to them by spinners and top-makers. Nearly the whole of the wool is grown in the Australian Colonies; it passes through the London sales, and in many instances it is sent direct by the purchasers to one of their establishments either in France or England. Mr. Isaac Holden, M.P., the head of the firm, is the inventor of the combing machine which is known by his name, and which, more than any other invention, has promoted the fine-combed wool industry of France and England, and developed the wool-growing resources of our Australian Colonies. While visiting the North of France for the purposes of this inquiry, we were invited to inspect the wool-combing works at Croix, and were accompanied through the various departments by Mr. Holden, and the other members of the firm.

Wool-combing establishments of Messrs. I. Holden & Sons.

All the details of the various processes were shown to us; the chemical preparation of the water for washing purposes, the making of the soap, the operations of washing, carding, and combing, and, not the least interesting or important, the extraction from the refuse soapsuds of all the grease, potash, and other valuable subtances, contained therein. A few years ago the whole of the dirty water from the washing-bowls was turned into the neighbouring stream and became a nuisance to all the users of the water beyond, but by dint of perseverance and the employment of a qualified chemist, the water is now released from the filtering tanks almost as pure as when it entered the washing-bowls, leaving behind it the valuable solid matter which is annually sold for many thousands of pounds sterling. The heads of departments and foremen are English, and many of the mechanics in the large repairing and constructing shop are Englishmen. The ordinary operatives are French, and their activity at their work, and healthy and cleanly looks, impressed us favourably. So great is the demand for Holden's combing that all the works of the firm, both in France and England, run day and night, with two shifts of hands. Connected with the works at Croix and Rheims, where at each place there is quite a colony of English families, there are English reading-rooms and libraries well stocked with books and daily

Processes of wool washing, combing, and recovery of waste products.

English newspapers; week-day and Sunday schools built and supported by the firm; and places of worship, with English pastors and services for the religious observances of the English families. The groups of English cottages, with their cultivated flower gardens attached, and the handsome residence and grounds of Mr. Crothers, Mr. Holden's nephew, close to the works at Croix, give a favourable and picturesque appearance to the village not usually observable in the manufacturing districts either of France or England. The total import of wool from the Australian Colonies, which passes through the London sales and is distributed to the manufacturing centres of England and the Continent, amounted in 1882 to 345,000,000 lbs. The wool combed annually by this firm represents more than two-fifths of the entire import,—a striking testimony, we may say in passing, of the services rendered to our Colonies and to European industry by Mr. Isaac Holden as an inventor, and as a promoter of the combed wool industry,—hence the very definite and reliable information which we were able to obtain from the firm with regard to the general capabilities of French and English operatives, and the relative cost of production in the two countries, is of the greatest value. The three branches of their works are situated in the three manufacturing centres of the combed wool industry of France and England. The premises in each case have been built and arranged on the same general plan. Advantage has been taken in each district of the special local resources and economies. In all the works the same machinery is employed, and in each case the same classes of wool, bought by customers at the London sales, are combed, and for the same subsequent uses. English managers, foremen, engineers, and mechanics, are employed at all the establishments, but the ordinary operatives are such as apply for employment in the three districts, and at such wages as are paid for labour by neighbouring firms.

Statistics relative to weight of wool combed by the firm.

Relative capabilities of of French and English workmen, and cost of production in the two countries.

All English machinery entering France is subjected to duty and other expenses, increasing its cost by fully 20 per cent., and similar increased expenses apply to all dutiable commodities used in the trade, such as iron and brass castings, leather, and the many smaller articles required in mill furnishing. Protective duties also affect to a serious degree some of the most important products which enter into regular consumption in a wool-combing establishment, such as soap, oil, and tallow, which are dearer in France than in England. Coal also, in Roubaix and Rheims, is on the average fully double the price of similar coal in England.

ncidence of mport and production duties.

In all the departments of the French works, excepting in those in which directing skill is required, the price paid for labour is much lower than is paid in England, and on a payment in wages alone of 2,500*l.* per week, the importance of this item is not likely to be overlooked.

Cost of labour lower than in England.

In bringing these comparisons to the final test of the cost of production in each country, by placing all the expenses in the

Cost of production in France is

French works against all the expenses of the English works, and in each case dividing them by the weight of wool combed, it was shown to us that, in spite of all the advantages of cheap labour, the cost of production is greater in France than in England. If this can be said of commercial establishments in France which possess all the advantages of the best English machinery, and all the stimulus of English enterprise, competition, and capital, it is but reasonable to expect that English works engaged in this branch of indnstry will compare favourably as to cost of production and efficiency, with the more ordinary rival works in France, and, perhaps, also in other countries.

greater than in England.

Silk Industry.—Lyons.

Lyons is the chief seat of the silk industry in France, and for the manufacture of the best classes of figured silk goods is acknowledged to be unrivalled in the world. In the city there are from 25,000 to 30,000 looms, and, including the outlying townships, considerably over 100,000. It was stated to us that in the several branches of the silk industry there are not less than 100,000 persons employed in Lyons alone.

Extent of the Lyons silk trade.

Thanks to the assistance of Mr. Haden, the British Consul, we visited, in addition to the more important schools, some of the leading works, such as dyeworks, the silk conditioning house, and the weaving shops of some of the best silk weavers. We were also introduced to several of the chief citizens, who were greatly interested in our visit, and courteously answered our inquiries.

All the complicated patterns and most of the plain silks are still woven by hand, and attempts to introduce power looms on an extensive scale have been met by fierce opposition. In Switzerland, in Germany, and in England, not only plain, but figured silks are being extensively woven by power, with the natural result that these countries are gradually taking the trade away from Lyons, in goods which are not of the very highest class. The manufacturers feel that they are at a great disadvantage with their antiquated system, as compared with their enterprising rivals, and they spoke of their future prospects with great concern. From time immemorial the weaving has been conducted in the houses of the operatives; every workman has his own loom—in many instances the one valuable piece of furniture in his one-roomed attic; and the great majority seem determined to struggle against their fate with daily lessening earnings rather than dispense with their hand-looms, and become mere operatives in factories. The most recent attempt to win over this great and stubborn population of weavers to a better state of things, is shown in the

Hand weaving.

Introduction of gas engines.

action of an influential society formed for supplying to the weavers small gas engines, which can be fixed in their own homes. These engines are of several sizes, representing half, three-quarters, and one horse-power. They take up very little room, can be easily moved and fitted to the gaspipe in the room, and they are offered at a small weekly rental, or are sold to the weavers at cost price, payable in weekly instalments. In many houses there are two, three, or four looms, and in some even more, and these occupiers are being tempted, in occasional instances, to try a gas engine. The hand-looms are fitted up so as to run by power later on; as the weavers become gradually trained to the use of power, and appreciate its advantage, modern power looms are put in, and, as is natural, the income of the weavers is augmented and their physical labour lessened. The promoters of the movement hope that, by thus putting in "the thin end of the wedge," they will convert the weavers gradually to the appreciation and adoption of the power-loom system, and thus save them from the ruin that must ultimately come upon them unless some such change be made.

Visit to Lyons' weaving shops.

We visited some cottages into which the gas engines had been introduced, and found in one instance a winding frame also running by power. In most of the looms the silks were plain, but we noted two power-looms with jacquards and figured patterns. We were told that the best articles, whether plain or figured, cannot be woven by the power-loom. In one of the ordinary cottages under the old system we found a workman and his family at work. There were four looms minded by the father, son, and two daughters, while the mother was cooking the dinner in a small living room adjoining. In one loom there was a gorgeous pattern of brocaded velvet, in which the weaver worked the shuttle by hand, and with each pick a boy drew out a wire, which raised the pile. The weaver managed the intricate operations, and cut the doubled threads so as to make the pile as he went along,—a slow process, requiring the constant attention of himself and the boy. We were told that the weaving of half a yard of such a pattern is a good day's work, for which the payment would be about 4*s.* 9*d.*, with a deduction of 10*d.* for the boy. This was a fair sample of the best weaving in Lyons. For ordinary weaving 2*s.* 6*d.* to 3*s.* is considered good average wages; on the power loom some of the weavers earn from 4*s.* to 5*s.* a day. The Lyons weavers are not bound to any fixed hours for working. There are some who scarcely ever leave the looms, excepting for food and scanty rest, and, on the other hand, there are many idlers. A practical weaver with whom we conversed informed us that 11 hours constitute a recognised day's work, from 6 a.m. to 7 p.m., with an interval of two hours for three meals. The first meal, of which we saw a family partaking (each portion being brought by the mother to the worker at the loom), consisted of a thin decoction, almost entirely water, in which there were sops of bread and potatoes; the

Wages.

Food of weavers.

second meal—dinner—consists of bread, potatoes, and usually a little meat; while the third is usually a repetition of the first.

Irregularity of employment.

One of the greatest troubles to be contended with in the Lyons silk trade, is the irregularity of employment. There are certain dead seasons, when work is not given out, and in many instances the weavers are not employed more than half their time. The result is that there is often much suffering and discontent, in good times excesses, in bad times penury; and consumption and brain diseases arise from the nature of the employment and the unhealthy conditions under which many of the operatives work.

Conversation on influence of the Martinière school.

One of the leading merchants spoke very highly of the Martinière school as having been attended by some of the best master dyers, and as having laid the foundation of drawing in the case of many students who had afterwards excelled at the School of Fine Arts.

Superiority due to men more than masters.

With regard to the silk trade, he was of opinion that its superiority in Lyons had always been due more to the weavers than the masters. There had not been in the past much sympathy between the two classes, probably owing in a great measure to the fact that the employer seldom saw his workpeople, except when they came to his warehouse for material or for wages; not having a factory and machinery, he was not under any obligation to find regular work for them, or to improve their machinery so that better work could be done. The skill of many of the Lyons weavers is simply marvellous, and families have for generations been distinguished for dexterity and delicacy of manipulation. From father to son the loom has been handed down, and the weavers meet together and talk of their work until technical knowledge has become natural to them, and skill has been raised to a high degree of excellence. "They have " all, however, both masters and men, fallen behind the times in " enterprise, clinging to traditions and old-fashioned methods, " while their competitors have been organising factories and " teaching their workpeople the use of the power loom." It was stated that "during the last 10 years Lyons has lost very much " of its trade, and now only takes the lead in specialities which " are most subject to the changes of fashion."

Loss of trade.

Original designing.

On the question of original designing, it was said that the Lyons designers are not as a rule artists. The talent cultivated by them is that of applying designs to the looms, and not so much of producing the designs themselves. The best designs come from Paris to Lyons, as from Paris to Manchester, and although drawing is taught everywhere, in none of the schools is it applied to the making of designs for textile patterns. Many of the o[illegible]s, however, can draw and can make original desi[illegible] the leading Parisian designers are natives of [illegible]d all that they know of technical

designing in the schools and weaving shops of this city, but they remove to Paris as a more favourable market than Lyons for the disposal of the talent which they have to sell.

Prospects of English competition in silk goods.

As to the prospects of England ever becoming a formidable competitor in the silk industry, one of the prominent citizens, who seemed to be very familiar with England, ridiculed the idea as being chimerical. He said, "The silk trade can never "become important in England, because the English people have "no taste. Taste is not natural to the Englishman, and never "will be; your sunless climate, your smoky atmosphere, your "absence of art associations and surroundings, are all against "the inculcation of taste." "In France," he continued, "every-"thing is different; taste seems to be inborn in the Frenchman, "and it is cultivated at every step. You English are a "remarkable people, and you take the lead in many things, "but in taste you are far behind, and must be content to "remain so." Stress was laid on the fact that in France all the children learn drawing as a part of their elementary education, and that the opportunities of continuing their instruction in art are infinitely greater and more generally taken advantage of than in England, and that in one school in Lyons (the Martinière) we might have counted a class of over 90 engaged in modelling. The question was put, "Suppose the order of things "were reversed,—that drawing and modelling should be taught "as meagrely in France as in England,—in effect, that they should "be banished from most of the elementary schools; and that "their extensive and general study as now found in France "should be adopted in England, what would you say of English "and French taste then?" Our friend replied that he was not prepared to say what would happen under improved teaching of art in England, but to banish such teaching from the elementary schools of France would be nothing less than a national calamity.

Superiority in dyeing.

On being asked how he accounted for the superiority of the silk dyeing of Lyons, he replied, "It is the water." "But," remarked one of the Commissioners, "if Lyons dyers removed to England, would they not dye as well"? "*Impossible!*" was the reply, "*you have not the water.*" We record opinions of this character because we heard them so frequently, and they show how even among well-informed men there is a tendency to be lulled into a feeling of false security by the mere possession of important natural advantages. An English merchant, long resident in Lyons, informed us that when the Swiss entered seriously into competition with Lyons, they were unsuccessful at first in their dyeing operations, and were compelled to send their yarns and pieces to Lyons to be dyed. The people at that time, as now, boasted of their incomparable water; but the enterprising Swiss manufacturers were not to be easily daunted; they engaged some dyers from Lyons, and they brought to bear upon the question the scientific knowledge of

their polytechnic schools; and now, remarked our informant, in many respects they surpass Lyons in dyeing, as they do also in some branches of weaving.

English silk trade.

Mr. Haden expressed an opinion that Manchester beats Lyons in cheap and ordinary fancies, and in good plain silks. In cravats, fancy handkerchiefs, and some other kinds of specialities, Macclesfield is at the head, and exports largely to Paris. In the most costly and elaborate silks, England is out of the competition.

Exports and imports.

The relative interchange of English and French manufactured silks may be understood by reference to the Board of Trade returns. In 1882 the exports of silk goods from England to France amounted to 1,034,486*l.*, against 618,850*l.* in 1878; the imports of silk goods from France amounted to 7,457,832*l.* in 1882, against 8,592,778*l.* in 1878; showing an increase in exports of 40 per cent., and a diminution in imports of 13 per cent. The total exports of manufactured silks and silk yarns from England in 1882 amounted to 3,517,847*l.*, against 2,488,217*l.* in 1878, while the imports amounted to 11,525,826*l.* in 1882, against 12,805,624*l.* in 1878, the increase in exports being 29 per cent., and the diminution in imports nearly 10 per cent. Considering that for many years silk has been and still is the weakest of the English textile industries, these figures indicate that not only are we gradually dispossessing the foreigner of his hold upon our home markets, but that we are also strengthening our position in the neutral markets of the world. While not claiming that these results are due to the influence of improved technical education in England, it is clear that they are not due to any advantages which we enjoy over the foreigner in cheapness of labour, or in obtaining the raw material of manufacture.

Chamber of Commerce, Lyons.

In a conversation with the President of the Chamber of Commerce, we were informed that the council of the Chamber consists of 18 members, elected by the holders of trade licenses, who pay a minimum tax amounting to about 10 francs (8*s.*) a year on a rental of 1,000 francs (40*l.*). The chief source of income, however, arises from the profits of the Silk Conditioning House, which is managed by the Chamber. From this source alone 5,000*l.* a year are realised. In some Chambers, of which Paris furnishes an example, an income is derived from the Custom House Agencies. The splendid income of the Lyons Chamber is disbursed in a remarkable manner for the benefit of objects of commercial and public usefulness. The Bourse or Exchange, the Industrial Museum, the Palace of Fine Arts, the Commercial and Weaving Schools, were built and are chiefly maintained out of these funds. Other useful commercial objects are promoted, such as the expenses connected with the exhibits from Lyons at the International Exhibition in Paris. The Chamber has [illegible] Society which makes grants to decayed and unfortu[illegible] or their widows and families.

Silk conditioning house, Lyons.

The silk-conditioning house is an establishment of great public importance, and is administered, as previously stated, by the Chamber of Commerce. Silk is the most costly of fibres, and its value is consequently affected more than any other by moisture and by the introduction of foreign elements. By custom, between buyer and seller, the condition of the raw material and of the yarn is tested by this public authority, whose decision in all matters is final.

The magnitude and importance of the establishment may be estimated from the fact that samples representing 4,000,000 kilos. a year are "conditioned," while an enormous number of reeling tests are made in order to certify regularity and strength of the yarn.

For testing the condition, the bulk is carted to the warehouse of the establishment; two samples from each bale are weighed on a balance of precision by two independent weighers, who work apart to secure impartiality. A third sample is put aside to be tested in the event of any discrepancy appearing in the weight of the two test samples. The samples are hung in a stove heated to 140 degrees, and dried until all moisture has been expelled. They are then weighed, and if the evaporation is the same in each the test is considered satisfactory. If not, the third sample is tested. The dry weight of the entire bulk of silk in a lot is calculated according to the tested samples from each bale. An addition of 11 per cent. is added to this weight by law, to allow for a return from absolute dryness to natural moisture, and the silk is then invoiced at this weight. A second test is made in order to ascertain the amount of gum or foreign matter. A sample is boiled for one hour in soap and water, and is passed through squeezing rollers so as to remove every foreign element. A certificate is then given of the weight so ascertained, allowing 25 per cent. gum for European and 17 per cent. for Japanese silk.

Uniformity and strength are tested by elaborate machines for the purpose, which indicate all irregularities. For these purposes a machine shown to us by the inventor, an American engineer, appeared to be a marvel of ingenuity and delicacy.

Engineering Works of Messrs. Schneider & Co., Le Creuzot, France.

Messrs. Schneider's works.

These magnificent works have been so frequently described, and a detailed account of them would occupy so large a space in this report, that we shall confine ourselves to a very brief statement of the facts bearing in the most direct manner on our enquiry. It is well known that these works, situated far in the interior of France, derive a large portion of their supplies of iron

ore—for the production of iron and steel of the most varied description—from Algeria; brought through Marseilles, from Savoy and other distant places; and that a considerable part also of the fuel used has to be brought from the coal basin of St. Etienne. This is rendered possible by extremely low railway rates—less than $\frac{1}{8}$ths of a penny per mile on iron ores, or less than half of the average rates charged in the United Kingdom. Most of the powerful tools used at Le Creuzot in the construction of marine engines, in boring large guns, and in planing armour plates, were formerly imported by them from England, but within the last few years these tools have been supplied by works in the east of France, and in the French departments now annexed to Germany. The French engineering tools were formerly ill designed, and badly proportioned. Now English models are followed, and the execution leaves nothing to be desired.

Training of the heads of departments.

A very small number of the heads of departments are former students of the great Parisian technical schools, several are from the École des Arts et Métiers, and many, including nearly all the foremen, have received no other instruction than that of the works and the exellent elementary schools founded and maintained by the firm. The head of the drawing office is one of these latter. The opinion of Mons. Henri Schneider was not favourable to the very high scientific courses of the Paris schools, except for men of remarkable ability, and of the energy and common sense necessary to acquire workshop practice at a comparatively late period of life, and to avoid a pedantic application of abstruse theory to practical work. His estimate of the Ecoles des Arts et Métiers, on the other hand, was very favourable. In several cases the firm had sent promising boys to those schools; but the workshop was held to be the true school for foremen.

Subjects of instruction in schools at Le Creuzot.

In the elementary schools connected with the works and carried on at the expense of the Company, great attention is given to geometrical drawing, and the work of the boys was surprisingly good. The elements of chemistry and physics are also taught. Night classes have been given up, partly because the instruction of the elementary day school was considered sufficient, and partly in consequence of difficulties between masters and men during the times immediately preceding, and succeeding to, the fall of the empire. The dissension which existed for a few years had, however, subsided to a great extent; and, although the firm employ large numbers of miners near Montceau-les-Mines, where there had lately been troubles, the Creuzot men had not taken any part in them.

During the stay of one of the Commissioners at Le Creuzot, a large hall, built at the cost of Mons. Henri Schneider, the managing partner, for theatrical performances, concerts, and other entertainments, and dedicated to the employés, was opened with a concert given by the excellent stringed band of which the workmen and clerks were the executants.

Education of managing partner, Le Creuzot.

We should add, that Mons. Henri Schneider himself did not receive a technical, but a classical education, and one of your Commissioners well remembers an interesting conversation with his father, the late Mons. Eugène Schneider, the founder of the great Creuzot works, in which that gentleman expressed his strong conviction that for the chief director of a great industrial enterprise, a good general education, and not a special one in any direction, was the only proper preparation.

Cotton Spinning in Switzerland. Factories of M.M. Heinrich Kunz, Windisch, near Zurich.

Cotton spinning near Zurich.

The Commissioners were indebted to the kindness of Mr. Hans Wunderly, head of the firm of M.M. Heinrich Kunz, for much information respecting the cotton industry of Switzerland. He also invited us to visit one of the groups of cotton factories belonging to the firm, and courteously allowed free use to be made of notes taken during the inspection.

Mr. Hans Wunderly.

His training.

Mr. Wunderly, like most of the employers whom we met in Switzerland, possesses a thorough knowledge of his business, and is well acquainted with England. After completing his ordinary school education in his own country, and becoming familiar with the general routine of a cotton factory, he came to England to study the language and habits of the people, and also to learn every detail of the cotton industry. For a time he was in a broker's office in Liverpool, noting and sampling raw cotton on arrival, mixing with the buyers and sellers "on change," and studying commercial accounts. Then he went through one or two spinning mills as a working apprentice, keeping mill hours, associating with the workmen, and even lodging with one of them. He also worked as a helpmate in the setting up of machinery in several large factories in Lancashire. Finally he entered a merchant's warehouse and office, and became acquainted with all the details of the exportation and distribution of cotton yarns. He afterwards made himself acquainted with the cotton industry of continental countries. While in England and in other countries, he constantly communicated to his firm such information as he considered would be useful. He thus became familiar with English machinery and methods of work, with the habits of the workpeople, and the general customs of the country, and still, in his frequent visits, he keeps up his inquiries, compares notes, and modifies or confirms his early impressions.

His opinion of English workmen.

He considers that the English are at the head of all the workmen he has ever seen, and he is familiar with those of France, Switzerland, Germany, and Italy. In practical knowledge of their work, in mechanical genius, they are better, w[illegible] [illegible]ical instruction, than the continental workmen ar[illegible] [illegible]n

physical endurance and "all round" capacity, they know no rivals. But English workmen would be better even than they are, with more education. He always found lack of education to be their weak point, and elementary schools like those of Switzerland would do wonders for them in the way of developing their natural intelligence.

His cotton mills, the largest on the continent.

The firm of which Mr. Wunderly is the head, is said to be the largest cotton spinning firm on the continent of Europe, and until within a few years the largest in the world. They own eight groups of cotton factories, situated in or near to the canton of Zurich, with a total of 243,000 spindles, turned to the extent of 2,300 horse-power by water, and 200 horse-power by steam They employ 2,700 hands. Their chief departments are spinning and doubling, and they have also a large mechanics' shop for the construction of small machines, and for repairs.

Visit to Windisch.

The factories selected for our visit were at Windisch, near to the railway from Basle to Zurich. We left the railway at Brugg, where a carriage was in waiting to take us to the factories. Mr. Wunderly pointed out a large warehouse at the station, which the firm use for the storage of raw cotton, much of which they buy in Egypt or obtain direct from America, occasionally from Bremen, but mainly from Liverpool. They prefer to buy in several markets so as to have liberty of choice when prices fluctuate from purely local causes.

Situation of Windisch.

The village of Windisch stands on elevated ground near a sharp bend of the river Reuss, which is crossed by a substantial bridge. The mills in the hollow are beautifully situated in a narrow part of the valley, surrounded by cultivated meadows and wooded slopes, and but a short distance from the meeting place of three important Swiss rivers, the Reuss, the Limmat, and the Aar. These rivers form the outlets respectively for the Lake of Lucerne, the Lake of Zurich, and the Lakes of Thun and Brienz, with their unfailing supplies of water power.

Hospital for workpeople.

On our way to the mills we passed the hospital built by the firm; a pretty building, healthily situated on the hill side, and surrounded by a flower garden. There is accommodation for 30 beds, but as yet only 16 have been provided. There can be no better testimony to the healthiness of the neighbourhood than this, that although the building has been erected since 1873, it has happily never been required. It serves the purpose of a dispensary, however, and in one of the rooms the doctor of the district meets the sick of the mills for advice, or for dispensing medicine.

Artizans' cottages.

From the hospital the road passes blocks of neat cottages, occupied by workpeople, and one hundred families are thus supplied by the firm with dwellings clustering in convenient situations, at short distances from the factories. On the right bank of the river, near the bridge crossing over to the mills,

is a flour mill belonging to the firm, and at this point the Reuss, which is a rapid river flowing over a stony bed, is about a hundred yards wide.

Cotton mills, Windisch.

There are three mills, two of which were built nearly fifty years ago. They are each six storeys high, exclusive of basement and attic. The third is a comparatively new mill, six storeys high, twenty-two windows long, and six windows wide; connected with it is a substantial building used for the mixing and scutching departments. The two older mills stand in a line, with a "race" between, and here originally two undershot

Water power.

waterwheels were fixed, which ran the two mills. The picturesque waterwheels have, however, disappeared, and the motive power for the three mills is now supplied by six turbines, indicating over 1,000 horse power, with an arrangement of special pumps for forcing water at high pressure over any of the mills in case of fire. Hose is distributed everywhere, and by electrical communication from all parts of the works, the apparatus can be set to work almost instantaneously.

Relative costliness of water powers.

The sight of such a magnificent supply of water, fed by so inexhaustible a reservoir as the Lake of Lucerne, and brought under such effective control, suggested to the Commissioners the possibility of a still greater development of this source of power. But Mr. Wunderly argued that it is a great mistake to suppose that water power is cheap. These turbines, made by an eminent Swiss firm of engineers, together with the canal, embankment, weir, and house, cost over 70,000*l*., almost as much as the mills themselves, and the annual cost of maintenance, taking into account the ravages of floods, is incomparably greater than that of engines and boilers. Then it must be further considered that water power is nearly always, as in this case, inconveniently situated, far away from the markets for the purchase of the raw material and for the sale of the manufactured goods.

After inspecting the turbines, Mr. Wunderly conducted us over the mills, showing us every detail, and freely answering every question.

Machinery.

We found Swiss, Alsatian, and English machinery working side by side without any preference being expressed for the English over the foreign. We were informed that English machinery costs from 20 to 30 per cent. more to lay down in Switzerland than in Lancashire, but that it is, if anything, cheaper than that made either in Switzerland or Germany. At Windisch they make much of their small machinery themselves, buying castings for the purpose.

Mules of various sizes employed.

We noticed considerable variety in the length and gauge of the mules, so as to suit the various counts and qualities spun. The firm are fully alive to all improvements, and a large number

Mode of working compared with Lancashire.

of their frames contain upwards of 1,000 spindles each. In comparing the speed of spindles with those of England, Mr. Wunderly said that they did not, and could not, if they would,

work at the high speed of Lancashire. It is no part of their plan to try for a great output. They are far more concerned to procure excellence than quantity. In the factories of Lancashire the general aim is to spin one or two counts and turn off as great a quantity as possible per spindle. Here there is variety without end. Specialities are made, from 30s to 100s, in single and two fold yarns, and often considerably higher counts are spun. They make fine embroidery and glove yarns, warps for silk ribbon weaving, cotton yarns to mix with silk, and knittings in all counts, but they do not spin weft for ordinary calicoes. They trade with many countries, and spin yarn for many purposes. They have to compete with highly favoured rivals in France, Germany, and Belgium, but the most formidable of all their rivals is England, and thus they need to take infinite pains in all they do, and rather select than avoid those classes of trade in which special care and skill are necessary.

Quality, not quantity, the chief aim.

These mills contain 80,000 spindles, with all the requisites for carding, preparing, and reeling. Including mechanics, masons, joiners, gas makers, and clerks, the operatives at these mills number 1,080. The hours of labour are not so long in Switzerland as in France and Germany; the Factory Act limits the employment to 11 hours per day, and no children under 14 may be employed. As a matter of fact, the restrictions against child labour are so severe that none are admitted to these works until they have passed their 15th birthday. The total hours are 65 per week, and even in case of making up for time lost by shortness of water, the permission of Government must be obtained. Under certain exceptional conditions machinery may be worked all night, but one set of hands may not work more than 11 hours. There are cases in which men work in factories 12 hours a day, but youths under 18 years of age, never.

Hours of labour. Restrictions.

Wages are nearly all paid by piece, and Mr. Wunderly is of opinion that piece-work is most satisfactory, both to employers and employed. The self-acting mules are minded mostly by men who earn from 2*s*. 3*d*. to 2*s*. 9*d*. per day. The women engaged in carding, drawing, roving, and reeling, earn from 1*s*. 7*d*. to 2*s*. 2*d*. per day; children from 14 to 17 from 11*d*. to 1*s*. 2*d*. per day. Wages are paid monthly, and one week's wages are always kept in hand according to law.

Wages.

Operatives have always been fairly plentiful. In fact, during recent years they have almost been too plentiful, and occasionally there is a difficulty in finding employment for families for whose condition the employers felt themselves somewhat responsible. It is true that, in this respect, they obtain some advantages in wages, but they are often compelled to employ inefficient hands. We noticed in the scutching room of one of the mills that three r four, or perhaps more men, of weak intellect were employed. ese men were affected with cretinism, but were not absolute

Workpeople, their condition

idiots. Mr. Wunderly pointed them out as illustrating the difficulty in a country village, of scrupulously selecting the hands. He had another reason for employing these half-witted men and making the best of them. In all probability, if they were not here, they would have to be maintained out of the poor-rate, which the firm have to pay almost entirely. Work-people remain with the firm from generation to generation, and great kindness is shown to the aged and superannuated. All the overlookers are trained on the spot, and men from other places are rarely employed in this capacity. The firm has adopted the principle of giving its high positions to its own deserving people, and aspiring young men are thus encouraged to look for promotion at home rather than elsewhere. Thus a feeling of clanship has been established which has kept the workpeople united, while there have been all sorts of disputes at other places. Mr. Wunderly was able to justify, with par-donable pride, the attachment of the workpeople for their em-ployers, by stating that during his lifetime they have not run any short time. Even during the late depression they kept their machinery going, and never stopped their works during the American war.

Foremen are home-trained.

General observations on the works, Windisch.

The general appearance of the mills was very satisfactory. No amount of special preparation for our visit could have placed the rooms in such a trim and tidy condition as that in which we found them. The machinery was marvellously clear of waste; the bright parts were polished. In the card rooms were ven-tilating shafts, carefully contrived, for conveying away the dust. In some of the spinning rooms pure air from the outside was distributed by effective mechanical means. The arrangements for ventilation were better than we usually saw in factories, and the walls might have been lime-washed but a week before, so clean and white did they appear.

Cleanliness.

The appearance of the mills from outside was equally striking. The walls were beautifully white; not the slightest evidence of smoke could be seen, and the windows from top to bottom were polished quite clean. Between the old and new mills was a meadow of long mowing grass ready for cutting. On each side were gardens with innumerable fruit trees in full blossom.

Public gardens.

The English observer is so accustomed to associate cotton factories with a smoky atmosphere and cheerless dwellings, that it is positively refreshing to record, from actual observation, an instance of busy industrial life amidst rural beauty. Opening from the office was an extensive garden, with wide and lofty verandahs, trellised with vines and roses, and shading a number of seats and tables. Here in summer time the workpeople sit in the shade and eat their meals, which they share with many familiar birds; for while we sat, the gold-finches, which were exceedingly tame, perched on the chairs and seats close by, and Mr. Wunderly said that they even ate from the hands of some of his men. The garden extends to the river.

and skirting the bank is a verandah about a hundred yards long, which, we were told, is literally covered with roses in the summer time. Along the walks were tubs containing orange trees, large fuchsias, and plants that can only live outside in the summer months; these are kept in winter in a heated room next to the gasworks. Across the river is a sloping bank, wooded with fine trees, and laid out in walks. All these gardens are open to the workpeople, and neither fruit nor flowers are ever disturbed—not even by the children. Few lessons are more successfully taught to all classes in Switzerland than that they must keep their fingers from picking and stealing. We noticed frequently in our visits to works of various kinds, that the roads leading to them were skirted by unfenced vineyards and orchards, and yet we were frequently told that the fruit is never disturbed.

Beauty of gardens.

The gardens and walks adjacent to the mills at Windisch have about them a beauty of which dwellers in English factory towns have no conception, and Mr. Wunderly's enthusiasm was justified as he pointed out that what we saw represented the labour and thought of three generations, each of which had endeavoured to do its part in making the place comfortable and pleasant for the workers employed in it. His children will recognise it as their first care to keep the place comfortable and attractive in future.

Absence of strikes.

The firm has never had a strike at any of its factories; but exemption from this unpleasantness was not attributed by Mr. Wunderly to the good management alone; the workpeople had shown great consideration in times of difficulty.

Drunkenness extremely rare.

Time-breaking through drink was an unheard-of trouble of factory-management; in fact a drunken man at Windisch is even a rarity at the village feast.

Mr. J. J. Meyer.

Such is a brief description of the picturesque factories at Windisch, but the inspection of the locality did not end here. We were conducted over the cottages, schools, and hospital by Mr. J. J. Meyer, an elderly confidential servant, who worked under Mr. Wunderly's father, and had been here from boyhood. He is a kind of bailiff, looks after the property, superintends repairs, collects rents, &c. We were told that such men are to be found everywhere in the more advanced cantons, and his case is a good illustration of what is going on in Switzerland. He could speak a little English, was familiar with English literature, and had read most of Sir Walter Scott's novels and poems in the original and from his own copies. He named a wealthy and much respected merchant in England, known to the Commissioners, as a playmate of his own. Mr. Meyer had received his education in the village school. His two sons began their education in a similar way, and had continued it at higher schools. Next to nothing had been paid for their schooling, and yet one was now the foreign correspondent of the firm, and able to write several languages with ease. The other was holding an important situation as foreign correspondent and buyer in the

warehouse of an export merchant in England, and receiving a good salary.

Schools at Windisch.

We found at the infant school that the children were being taught by Kindergarten methods, and had a large collection of sewing and plaiting patterns on paper, coloured designs, boxes of toys, Noah's arks, bricks and sticks, &c., such as we find in the best schools in England. The desks, tables, and floor were scrubbed scrupulously clean, and the children were all neatly dressed and clean. They went through physical exercises, sang, counted, and gave evidence of being intelligently taught. There is also a junior elementary school, of which the fees, as of the infant school, are 1*d.* per month. Mr. Wunderly believes that even a small payment encourages appreciation of the schools, and tends to foster a spirit of independence among the parents. The older children attend the Windisch free school at some little distance from the factories, where they receive a sound primary education, as good as may be obtained in the larger towns. The parents and villagers generally are encouraged to take an interest in these schools by the good example of Mrs. Wunderly, who actively shares her husband's interest in the welfare of their employés. She provides a Christmas tree annually for the school children, and a little meeting is held at which they sing and show specimens of their work and scholarship, and here she and her husband meet the children and their parents, and each child receives a present from Mrs. Wunderly's hands.

Christmas treat.

These acts of consideration are not thrown away, and tend no less in Switzerland, than has often been found to be the case in England, to establish good feeling between employers and employed.

Night school free.

The young people are not neglected after their attendance at the day school has ceased. There is an excellent night school in connection with the mills, where several subjects are taught to the operatives free of charge. The draughtsman of the firm teaches mechanical and freehand drawing in the evenings and on Sundays; in addition to regular classes in literary subjects, courses of lectures are given during the winter months.

Visit to workmen's cottages.

The Commissioners were invited to visit the cottages, and some of these were inspected from cellar to attic. Unlike workmen's cottages in England, they are built in blocks, generally containing about nine tenements each, and arranged in flats, a staircase serving for three flats, each with its living room, kitchen, and two bedrooms. In each kitchen there is a cooking stove, sufficiently large to accommodate three pans boiling at the same time. A pleasing feature of many of these cottages was the interest taken in the culture of plants and flowers. The windows being all double, protect the interiors alike from winter cold and summer heat; boxes of mignonette and other fragrant flowers bloomed in the spaces between the outer and inner frames, and pots and bouquets of flowers adorned the rooms. There seemed to be white curtains to all the win-

dows, pictures and bookshelves on the walls, and pieces of carpet on the parlour and bedroom floors; the chairs, table, stove, and other fittings were all neatly arranged, and in most instances perfect in cleanliness.

Wash-house.

For the use of every two blocks of cottages we noticed a wash-house, containing a large "copper," a number of large tubs, and laundry table. The washing-day, which is responsible for so much discomfort in English homes, is deprived of its horrors at Windisch, by being relegated to this well arranged building.

Gardens.

Surrounding the cottages are the garden allotments, divided by walks, and displaying all the marvellous results of spade culture for which Switzerland is famed. Potatoes, and many other kinds of vegetables, were being grown for domestic use, and there were also fruit trees in blossom.

Rent.

It will not be considered that the rent of these cottages is excessive. The tenants pay less than 4*l.* a year, garden included, and the firm make all repairs of freehold, whitewash the houses inside and outside, and sweep the chimneys. The cottages, we were informed, do not pay more than one per cent. on the outlay upon them. Yet in spite of the favourable terms upon which dwellings may be rented, the ambition to live in one's own house is strongly manifested by these village artisans, and although we did not hear of special facilities for the building of houses, such as are afforded by the Building Societies of England, yet half the workmen of Windisch live in their own houses, a striking illustration of thrift and prosperity. Connected with every factory belonging to the firm is a sick club, through which the advice and help of the village doctor are obtained in case of sickness. As above-mentioned, the doctor has a dispensary at the hospital belonging to the works, and to the several sick clubs the firm are the principal subscribers.

Co-operative societies.

The co-operative supply movement was early taken up in Switzerland and vigorously promoted by this firm in all the little communities connected with their factories. At Windisch they started a society, managers were appointed, and the firm advanced them money at 4 per cent., for furnishing premises and buying a stock of goods. The shares are five francs each, and are taken up mostly by the workpeople. Food and clothing, and many of the luxuries as well as the necessaries of life, are supplied to the inhabitants. The accounts are audited by the firm, and of the profits, one third go to the customers in the form of bonus, one-third to the shareholders, and one-third to the reserve fund. The society acts also as a bank, and keeps money on deposit, allowing it to be taken out as required.

General education of the workpeople.

The Commissioners were favourably impressed with the general appearance of the workpeople. They were all very clean, and well dressed, and though generally short and thick set, and neither handsome nor pretty, they showed in a high degree the effects of comfort and civilization. We were assured that, except those who are physically or mentally incapacitated, not a child or

an aged person, within the wide area from which these factories draw their workpeople, is unable to read and write, and that through all ranks and conditions of the population the desire for education is as universal as the supply is effective and complete. It has been said by a careful inquirer, that "for thorough education the Swiss may be said to entertain a veritable passion," and to this generous determination the simple-minded peasants and factory operatives of the thriving valley of the Reuss are no exception.

Personal interest of the employers in their workpeople.

The members of the firm mix freely with their people, know their individual circumstances and family connections, and as all are educated, the difference in position is minimised by intellectual sympathy and civil and political equality.

Workpeople are well off in spite of relatively low wages.

Considering that, as compared with the English standard, the incomes of these people must be small, it is somewhat remarkable that the operatives generally present such a well-to-do and comfortable appearance. Besides maintaining their families and securing a good education for their children, it is the exception not to have something laid by for a rainy day, or for old age. It is contended that the industrial workpeople here and in other parts of Switzerland, are better off than those of surrounding countries. The military service bears so lightly upon the Swiss workman that it is not looked upon as a serious tax upon his labour. Compared with all other Continental countries, taxation falls lightly upon the poor. Hemmed in by countries with hostile tariffs, they buy freely, with merely nominal duties, all the cheap food, clothing, and raw materials that their neighbours have to sell. There is scarcely any indirect taxation upon their food and clothing, and direct taxation is lower than in France, Germany, or Italy. The purchasing power of their wages is, therefore, at a maximum, and wise expenditure must be credited with its share in the exceptional conditions of prosperity and happiness found among the cotton operatives at Windisch.

Cotton Factories at Nieder Toess, Winterthur.

Cotton mills of Messrs. Rieter.

The Commissioners, during their visit to Winterthur, also inspected the above factories belonging to Messrs. J. J. Rieter & Co. The buildings have been erected at different times. The power is derived from turbines, and is transmitted from one building to another by means of wire ropes of great length, running over drums of large diameter.

Conspicuous for cleanliness.

It is unnecessary to give any detailed description of these buildings, since with respect to hours, wages, and organization, they resemble the cotton factories at Windisch. We have sometimes suspected, that when factories have been visited by the Commissioners after due notice, a special "cleaning down" was made for our benefit, and that the trim, neat, and clean appearance of the rooms were thus to be accounted for.

Nothing of the kind could have occurred here, for our visit was unannounced. The buildings in the works were all spotlessly white, as if lime-washed the week before. The passages, staircases, &c. were faultlesssly clean. In the spinning rooms there did not seem to be a particle of fly or dust, or even grease stains on the floor. In convenient places were casks of water, with large water taps and buckets attached, for use in case of fire.

High speed not attempted.

In the spinning there was no attempt at high speed. The counts spun on the mules were 140^s and 150^s, for warps and yarns intended for gloves, lace, or for mixing with silk. The best cotton is used, and the cost of labour on a pound of yarn is considered unimportant compared with the advantage of securing excellence, and producing a yarn which pleases customers. In Italy, Saxony, and Westphalia, we found yarns from these factories used for mixing with silk, and woven into fine webs for cotton gloves; thus, in spite of the import duty, they were competing with home-made yarns in foreign countries and with English yarns in neutral markets.

Cottages for workpeople.

Near to the factories, as also to the machine works belonging to this firm, were blocks of cottages tenanted by their workpeople. Some of these cottages, with two living rooms, scullery, two bedrooms and attic, were rented at about 8*l.* a year, the garden included. Many of the operatives own the cottages they live in, or invest their savings in plots of land, in cultivating which they spend every spare moment. It was stated to us that this extensive possession of parcels of land by the masses is considered to be one of the chief safeguards against socialism in the country.

Calico-Printing.—Zurich.

Relative position of Swiss and English Calico-printers.

A large calico-printer, in comparing his position with that of his English rivals, stated that he was compelled to do a very varied trade, full of details, so as to satisfy many small customers in many countries. His packages contained large varieties and assorted patterns, and he found it necessary to take infinite pains to satisfy the small fancies or whims of his customers as to making up, packing, labels, and a hundred other things which English houses ignored.

Manufacturers must comply with vexatious stipulations of their customers.

In a foreign trade many foolish things were required, with which he complied. The English maker, when a paltry request involving trouble was made, would say that the thing was absurd, and would refuse to do it, and he often compelled the buyer to adopt the English plan or not get the English article. This had greatly disgusted foreign merchants, who had to please small shopkeepers, and these in turn the ignorant and prejudiced country people, who were often far more exacting as to the way in which an article was made up than as to the quality of the article itself.

English manufacturers disregarded these minute details.

In times when English goods only were offered in foreign markets, there was no choice for people but to buy goods as they were presented. Now-a-days several countries were competing in the same foreign shop for the same customer, and the humouring of the fancies of ignorant buyers was not the least important of a manufacturer's difficulties. It was ready attention to small things which enabled Swiss manufacturers to live. His travellers made personal visits to his customers, and would write letters, ten pages long, about the most trivial details, but he was willing to follow such instructions. It was only by care and attention to details that he could face the competition of England.

Workpeople are plentiful in Switzerland.

We were informed that, generally speaking, there is no scarcity of workpeople in Switzerland, and as manufacturers do not readily extend their works, there is no outlet but emigration for the surplus. This accounts for what may be considered low wages, but the operatives have some advantages as compared with their rivals in surrounding countries. They are almost free from taxes, and they escape the most exacting and serious of all taxes—the three years' military service, now almost universal throughout the continent of Europe. They command for their children good and free elementary education, and free evening and Sunday schools after the day's schooling is finished. Employment is remarkably regular, and free institutions teach them to be proud of their homes and their beautiful country. In the long winter evenings the girls sew and do housework, the boys attend the evening schools, and the elders are generally able to read. The favourite pastimes are inexpensive. Their mode of living must, indeed, be frugal and singularly moderate, or their small wages would not provide them, as do they with food and decent clothing, and something to lay by.

Emigrants, are as a rule, well educated and well off.

At Basle we saw 80 emigrants starting for America, and were informed that, in addition to their passage money, every one would have a surplus with which to begin life on the other side of the Atlantic. In some cases the stock of money was said to be small, but in others considerable, amounting to scores of pounds sterling. All these emigrants had received a sound education at school, and had occupied much of their leisure since that time in learning something of the geography, history, and special wants of the new world they were about to visit. These young men and young women, by virtue of a better education, would enter America with chances superior to those of the ordinary emigrants from England and Ireland, whose education in their own countries had been less cared for. But to whatever land the Swiss goes he knows that his good qualities will make him welcome, and his ambition is to return again to end his days in affluence among the mountains which he loves.

and the free institutions which have given inspiration to his life.*

Silk Weaving, Basle, Switzerland.

Swiss silk industry.

The silk industry has for several years past been increasing in importance in Switzerland. While it has languished in Spitalfields, Coventry, and Macclesfield, it has extended in Basle, and even Lyons has been compelled to acknowledge the formidable character of its enterprising rival.

In one of the large establishments visited by the Commissioners, ribbon weaving by power looms was carried to a high pitch of excellence. In some of the looms from 8 to 10 ribbons were woven at once, with as many shuttles. Some of the designs were very complicated, and required not only great ability on the part of the "tuner" to arrange the patterns in the Jacquard, but also great knowledge of the work and care in its execution on the part of the weaver.

Jacquard power loom for ribbon weaving.

In the Lyons and St. Etienne districts most of this work is done by hand; one is therefore not surprised at the remark of our conductor that Basle is beating Lyons and St. Etienne out of the market. If, in the one case, hand looms only are used, and in the other power looms for the same goods, we need not wonder that the advantage, at least for cheapness of production, will lie with the power looms.

Skilled overlookers arrange the looms.

The weavers are all able to "right" their own looms, and set the patterns, but they do not fix the Jacquards. This is done by overlookers, specially trained to arrange the looms in accordance with the figured design. These men have not had training in special schools, but they are all men of general intelligence, and many of them have received a good education in the ordinary schools. The manager of the works was of opinion that experience in the factory is the best training for an intelligent man. He did not pretend that the factory was the best place for training a designer, but no place could equal it for teaching a man how to put a design into the loom when the pattern had been made for him.

Designs for silk weaving.

All the silk manufacturers employ designers, but only a small proportion originate new patterns. We saw several designers at work, but apparently all were engaged in enlarging designs

* Note.—In the silk manufactures of Switzerland 56,285 workpeople were employed in 1882; 40,669 in cotton manufactures; 39,367 in watch-making; 17,776 in machine-making. The exports of cotton yarn and thread increased more than six-fold between 1860 and 1882. The annual value of articles embroidered by machinery is estimated at 3,200,000*l.* The wages in cotton spinning factories vary from a minimum of 1*s.* to a maximum of 3*s.* 4*d.* per day. The artizans in the silk factories of Basle earn from 7*s.* 3*d.* to 23*s.* 9*d.* per week; those of Zurich from 11*d.* to 3*s.* 1*d.* per day; workers in wool and worsted from 1*s.* to 2*s.* 10*d.*; men in linen factories, 2*s.* 1*d.* to 4*s.* 10*d.*; females in the same, 1*s.* 1*d.* to 1*s.* 4*d.* per day.

produced elsewhere. We were informed that drawing is well taught in Basle, and that original designers are produced and trained there, but the more important patterns for ribbons and for other silk products come from Paris, as is also the case in Lyons. The manufacturers generally receive all the new patterns from an agency in Paris, and they adapt their patterns from these, or imitate them in a cheap form. This arrangement does not apply in the case of the manufacturers of the best silks, in which the newest and original designs usually appear. Much of the work which we saw was evidently of the second class, from cheaper material, but intended to be as effective as possible for the price. For instance, the yarns were made mostly from waste silk and spoiled cocoons from Italy, China, and India. Many varieties of yarns and thread were being prepared from dyed silk yarn, which was twisted, singed, and wound upon small bobbins, then made up in fancy boxes, labelled for the English market, and called "*Sublime Sewing Silk.*"

Excellence of dyeing, Basle.

In dyeing, there are some colours in which they acknowledge the supremacy of Lyons, but generally they claim to be in advance of the French. This they attribute to the greater intelligence and superior chemical knowledge of the Swiss, in dealing with the new colouring matters which during recent years have so powerfully influenced the trade.

Hours of labour, wages, &c.

The operatives in the silk factories work 11 hours a day, and are nearly all paid by the piece, fortnightly. Their earnings are probably a little lower than those of similar operatives in England, and the power loom weavers are not paid so highly as the best hand loom weavers of Lyons.

Influence of technical instruction.

It was not shown to us that the silk industry of Basle, apart from the dyeing, has been materially influenced by technical schools, but the general schools are more scientific in character than the schools of England.

Attention to details in the manufacture.

The cheap labour of Switzerland is a strong point of advantage in the cost of production, when taken in connection with the important faculty of taking pains, which is shown both by the masters and by the workpeople. The high scientific training of employers and the heads of manufacturing establishments, exerts its due influence upon Swiss industries, while the general good education of the poorest artisans, enables them to do the most detailed work with intelligence, and with a sense of responsibility, knowing the value of the commodity with which they deal. The great care shown in every process almost in itself accounts for the growing preference with which certain Swiss goods are received in many markets.

ZURICH.—SILK DYEING.

Dye works at Zurich.

The Commissioners visited some interesting works near Zurich, where the operations of silk dyeing were inspected. As in Alsace, Basle, Lyons, and Crefeld, there is a great subdivision of

labour in all the processes. If at any place in the world one might expect to find chemists among the ordinary workmen, that place would be Zurich, where the highest chemical knowledge may be so cheaply obtained, and where its importance to industry is so thoroughly understood. Yet in this establishment we could not ascertain that the ordinary workmen had received theoretical training in chemistry. Experience seems to show what it is also reasonable to expect, that each of twenty uneducated men devoting his life to one thing, can do that thing better than any one man, even with the highest scientific training, can do twenty things. Here a man is kept at dyeing one shade until he can dye it perfectly. Division of work compensates for the lack of chemical and scientific knowledge. The difficulty in the case of these practical dyers arises when they have to deal with new colours or novel processes, and here their rule-of-thumb knowledge is inapplicable.

Workmen are not technically trained.

But at the head of these dyeing establishments, the Commissioners almost invariably found, in the persons of managers and foremen, high scientific knowledge combined with practical training.

Managers have received a scientific education.

The proprietor and director of one such establishment had been a chemical student at the Polytechnic at Zurich; he had afterwards served an apprenticeship at Lyons, because it was understood that silk dyeing had there attained its highest efficiency; and had subsequently worked in Paris and Manchester.

This is but one more instance of what was found by the Commissioners in France, Italy, Switzerland, Germany, Austria, Belgium, and Holland, namely, that in nearly every factory or industrial establishment of importance, the directing skill was supplied by men who had supplemented a scientific education by foreign travel. These men generally know what is going on in the best manufactories in England and other countries. As a rule, the arrangements of the newest and best of their factories and workshops, the efficiency of their machinery, and their appliances for economical production, are as good as our own. In chemical knowledge, the heads of departments in colour-making and dyeing establishments are almost invariably superior to those of England, where Englishmen educated only in England are employed.

Same fact observed in other countries.

Engineering and Machine Making, Switzerland.

Through the kindness of Oberst P. E. Hüber, Riesbach, Zurich, the Commissioners were shown over the machine and tool works of Oerlikon, near Zurich.

Engineering works at Zurich.

The firm make machine tools of many kinds, such as lathes, planing, drilling, and shaping machines, machines for working in

wood and stone. They also have a speciality for patent flour mills with porcelain rollers. Their machinery and tools are mostly exported, and a considerable number of their flour mills find their way to England.

About 440 men are employed, and no boys are taken under the age of 14.

Wages and piece-work Oerlikon.

Wages are paid almost entirely by piece. Apprentices during their first year are paid by the day, but their work is tested in the same way as that of the piece-workers. After the second year they are paid by piece, and after three or four years many execute as much work as journeymen. A good man will earn up to 5*s.* a day, while labourers who have not been apprenticed earn from 2*s.* 6*d.* to 3*s.* per day.

Hours.

They work 11 hours a day, excepting on Saturdays, when they work 10, thus making a total of 65 hours per week. They have no rule as to what is taught the apprentices. They do not

Apprentices.

take what in England are called "gentlemen apprentices," who pay a premium and are supposed to learn everything. There are, however, many boys whom they put through every department of their business without premium. But they do this for their own interest rather than in that of the boys. In a district where the iron industries are not extensively organised, and in a growing business, they must ever be on the look out for young men who may make good foremen, or who may be relied on to look after their interests in erecting machinery in other countries. They are therefore always ready to pick out young men of special intelligence and promise, to whom they give a more careful training, and whom they put forward in other ways. Such young men usually appreciate and justify the confidence placed in them, by efforts at theoretical improvement out of work hours, and it is quite common for them to learn the English language and to study English books.

Opinions respecting piece-work.

In a conversation on piece-work, our conductor said that the men do not, as a rule, object to it. He was of opinion that its advantages are universally recognised. What is objected to with regard to piece-work is the frequent lowering of the rate as higher wages are made, and the selfishness of employers as much as the greed of men, has been the cause of many strikes and cases of unpleasantness. Employers have encouraged men to put out their full strength, and finding that they earned higher wages than they previously obtained for day-work, have lowered the rate, thus necessitating still harder work to keep up the pay. Against this system the men in some works are constantly fighting. As one of the large machine-makers of Alsace remarked to the Commissioners, "The men are wise enough not to put out "their full strength, for fear that the rate may be lowered." On the other hand, it was represented to us that in many instances, in which, by improved tools or other materials supplied by the employers, the workmen have been able to work

more expeditiously, and increase their earnings, they have refused to submit to a proportionate reduction of the rate, and thus the unpleasant feeling relating to piece-work has been kept alive. At these works the men have always been encouraged to put all their energies into their work without fear of advantage being taken, because employers and employed have mutually gained by the maximum of work being done.

Division of labour.

As for division of labour, it is as well understood and is as much cultivated as in England. Under a system of payment by piece the men like it, because they can make most money by it, and the masters encourage it because it enables them to make the most perfect and the cheapest machinery.

Employer retains one week's wages.

Payment of wages is made fortnightly. According to the rule, supported by law, which we found in operation in most of the countries visited, a week's wages are always held in hand, and this tends to keep the workmen steady, and checks frivolous changing from one shop to another.

Draughtsmen.

Ten draughtsmen are employed on the works, and the drawings are reproduced by the ferro-prussiate process, now common in the engineer's shops of this country and the continent.

Coal.

Coal costs about 16*s.* a ton. The carriage of goods to London is about 4*l.* a ton.

Managers are scientifically trained.

Although in the selection of heads of departments, other qualities besides scholastic knowledge and training have always been taken into account, nearly all the head men in these works have been through the Polytechnic or the Technicum.

Abundance of highly trained students.

Every Polytechnic student expects to take a position higher than that of the ordinary workman; but in the Swiss machine and engineering shops, which are comparatively few in number, students from the higher schools are so numerous that many of them necessarily begin as ordinary workmen, and some never rise beyond this position. With some of these highly educated youths it is rather a disadvantage to themselves that they should have remained at school till twenty years of age, because a few years must elapse before they possess the expertness of ordinary workmen, whereas the boys who begin wage-earning at fourteen, generally receive sufficient education in the elementary schools to enable them to perform intelligently all the work required of them. As *ordinary* workmen, assuming that there were no possibilities of advancement, it was represented to us that the boy coming to the shop at fourteen becomes, as a rule, a more skilled and valuable artisan than the highly educated youth coming at twenty. In actual experience of workshop government it does, however, generally happen that the highest positions are eventually secured by youths of superior education and scientific training, although in Switzerland the supply is greater than the demand, and consequently many must remain workmen, or emigrate to some other country where there is a better field

Opinions respecting the advantages of a polytechnic training.

for their scientific attainments. To sum up the evidence of the heads of this firm on this interesting question, it was held that if a workman possesses those moral qualities which fit him for a higher position, such as that of foreman or manager, the acquisition of scientific training is of the greatest value to him; indeed for the higher posts it is indispensable, whilst for foremen it is second only to a thorough knowledge of work and the management of men. There are many workmen and foremen possessing practical skill and high scientific knowledge who have not attended a Polytechnic School, and there are some who have enjoyed the fullest advantages of the Polytechnic School who are not only much inferior in practice, but are very deficient in scientific knowledge also, to others who have enjoyed fewer educational advantages.

Education for foremen.

Mr. Hüber is of opinion that a workman, by enabling his boy to remain at school till he is sixteen, so that he may go through the secondary school course, opens up to him the highest possibilities of future advancement. Such a boy beginning to work at sixteen, and attending a night school, may with strength, ability, good conduct, and ambition, qualify himself for any position which he desires to attain.

Education for employer.

A manufacturer's son, who is intended for an industrial or commercial career, cannot do better than begin his education at the elementary school among the children with whom he will be connected in after life. He will learn to respect and admire the good qualities of his playmates, he will better understand their weak points and know how to deal with them. Good fellowship and sympathy between master and man are qualities that possess a commercial as well as a moral value. Moreover, in Switzerland the public free school is the *best* school for an elementary education. Mr. Hüber's own son attended a primary free school; after that the Real Gymnasium for a three years' course; he is there now, and his father expects him to get a general training in science and modern languages till he is turned eighteen. He will then enter the workshop for a year to learn the use of tools, and to obtain a general knowledge of the terms used in the shop, the purposes of the machines, &c. From the shop his father hopes to send him to the Polytechnic School for three years. By that time he ought to be a thoroughly qualified engineer, able to take his place by the side of the capable men of all countries.

Conversation with working engineer.

In going over these works, the Commissioners had a conversation with a very intelligent foreman engineer. After working in a shop as a boy, he attended the department for engineering in the Zurich Polytechnic, and having finished the course, he fulfilled the dream of all ambitious young men by travelling to England. There he visited some of the engineering works of Yorkshire and Lancashire; worked in the drawing office of one of the large machine makers at Oldham, and was employed in other capacities at some of the leading establishments in the North of England.

His opinion of English workmen.

He greatly respects the Englishman, who has, he thinks, more natural aptitude than any other workman he has seen, and greater physical strength, which he considers may be mainly accounted for by the fact that he lives better. There is, however, a great gap between the best English workmen and the worst. Nowhere has he seen so much drunkenness and coarseness, amounting almost to brutality, as among the lower orders of English mechanics with whom he has worked. It was a great surprise to him when he visited England, to find in workshops where the best work he has ever seen was being done, many men in such a state of ignorance. He does not think that the Englishman shines as a workman outside of his own country. He is apt to be conceited and domineering, and irregular in his habits. A few years ago English workmen were extensively employed in Swiss workshops. At present he does not know of any establishment where a single English mechanic is employed.

English workwomen as housewives.

Of English factory women as wives he has not a high opinion. They are not educated; they work in factories up to the time of marriage; they learn very little of household work, and when they marry and set up house, many of them have no notion how to make their husbands comfortable, or to make both ends meet. With large incomes from a Swiss workman's point of view, they have not been trained in ideas and habits of economy; they have to begin to learn household management at a time when they ought already to understand it, and not being able to make their homes attractive, their husbands escape from the untidiness and squalor of home, and spend their evenings at the public-house. The engineer remarked that when he looked on the brighter side of English social life among workmen and their homes, he had to acknowledge that he had seen nothing elsewhere so favourable. But he was not less impressed by the discomfort caused by lack of education and of knowledge of domestic economy, which brought wastefulness and drunkenness in their train. He was of opinion that in education and household management, the women of Switzerland of his own class are far in advance of the women of England.

Education of the poor.

The educational facilities offered to the poor in Switzerland are beyond all praise, and are highly appreciated by them. Besides the free day-schools there are the free evening and Sunday schools, and in the Canton of Zurich, at least, the apprentices and workmen have only themselves to blame, if they do not continue their education in any direction in which they may desire to excel. He looks upon the free schools of Switzerland as the mainstay of Swiss independence.

Military system.

On the influence of the Swiss military system he gave some interesting information. Military service we need hardly say begins at 20, and the rule is that all men are required to go through a prescribed service of six weeks a year for eight years. From 28 to 30 the service is reduced to two weeks or ten days

a year. From 30 to 40 years of age, eight days' exercise is required every two years. It is understood that throughout life every able-bodied Swiss is required to place his services at the call of the Republic for the defence of the country.

When on service the soldier gets his military dress and food from the State, and 10*d.* to 2*s.* and 2*s.* 6*d.* per day. It is the custom for workmen to assist each other and their families during absence, out of club funds subscribed partly for this purpose.

Wages of superior men are paid while they are absent on military service.

In the case of superior men in workshops or factories, particularly of those paid by month or quarter, their wages are generally paid by their employers, as a matter of agreement during absence on military service.

Industrially, neither employers nor employed attach much importance to this periodical absence on military service. It applies to both masters and men, and as it must be gone through, they provide for it without appeal or question. The drill goes on during most of the year, and large firms divide their men, so many a month, while the drilling period lasts. It is a healthy change, is generally enjoyed, and the men come back to their work as strong as oxen.

Machine and Turbine Making Works of Messrs. J. J. Rieter & Co.—Ober Toess, Winterthur.

Engineering works of Messrs. Rieter.

These works are situated at the village of Ober Toess, about a mile from Winterthur.

In addition to turbine wheels and heavy tools, the firm make lace machines and every kind of cotton-spinning machinery, which they export to all manufacturing countries except England. In the case of turbines they occasionally receive orders from England. They employ 800 mechanics, and having no foundry of their own, they are supplied with most of their castings by Messrs. Sultzer Brothers, whose extensive foundries we passed near the station at Winterthur.

Arrangement of works.

The training of mechanics and the arrangements of the shops generally, are not very different from those of England. The principle of division of labour is carried on extensively in the making of such machines as cotton-mules, where the many parts are duplicated, and machine tools are extensively employed; but in the turbine department, where two machines are seldom of the same dimensions, subdivision is less frequently attempted.

Apprentices and their training.

Apprentices come at 14, but if backward in their education, they are either refused admission until they have reached the necessary standard, or are required to attend school for two half-days per week in addition to the night school. They are tasked almost at once as if on piece-work, and their work is inspected so that they may be kept up to the mark with regard both to quality and quantity, but they are not paid by

piece during their term of apprenticeship. They are advanced in wages from year to year according to rule, and partly according to proficiency. They are often changed from one class of work to another, smart fellows being picked out for more important work. Many of these young men are taught turning, fitting, and engineering, and thus become conversant with the varied work of the establishment. The firm have found the importance of having a number of all-round men, so that in the event of special men being off their work, or leaving at awkward times, there may be no serious difficulty in supplying their places.

All the workmen understand drawing.

All the men engaged on turbines, or similar engineering work, are accustomed to work from drawings; in fact, most of the men can make drawings of their own. Nearly 30 draughtsmen are employed in these works, of whom the majority were trained at the Technicum of Winterthur, or in the Zurich or other Polytechnic school. Some of the draughtsmen assist in the evening schools. These are held in the village during the winter, and are free to all comers.

Hours and wages.

The men work 65 hours per week, as at the mills and workshops of Switzerland generally, and their payment is by piece. Ordinary workmen earn from three to four francs per day, but some men were receiving very much higher wages. "No rate of payment for piece-work could be devised," said Mr. Rieter, "that would not give exceptionally high wages to exceptional "men."

Piecework.

On the question of the length of working hours and the rate of wages, an opinion was expressed, that under piece-work the number of hours that a man works is not a very serious consideration. When a man works his hardest, he can exhaust his energy in ten hours almost as completely as in twelve. With shorter hours he quickens his pace, and the extra two hours of relaxation at night which the ten hours' man obtains, bring him to his work next morning fresher and more vigorous than the man who habitually works two hours a day more.

Works driven by water power.

These works are driven entirely by water, and the power is transmitted from one building to another by ropes which seemed to be very steady and effective. Mr. Rieter, like Mr. Wunderly, would not admit that there is much economy in water-power. With the present comparatively cheap supply of coal, and its economical use in the production of steam, it is preferable to water-power, except where regularity of water-supply and immunity from floods can be secured. The wear-and-tear of water-power is excessive; deficiency in the supply always comes at busy times, when it is most wanted, or the floods come and cause constant anxiety, or even terrible havoc. Less than ten years ago, a terrible winter flood destroyed all the weirs, flooded the shops and offices, stopped the works for a considerable time, threw all the workpeople out of employment, and did damage to the extent of 16,000*l*. There are few people in Switzerland who use water-power extensively, who do not suffer these disasters at one time or another.

ZURICH.—EARTHENWARE FACTORY.

Earthenware factory at Zurich.

The Commissioners visited an earthenware factory at Zurich, and saw the manufacture of tiles for wainscoting, and of the terra-cotta and earthenware stoves so extensively found in houses throughout Switzerland, Germany, and Northern Europe.

Some of the modelling was very superior, and the glazing of the pottery was skilfully executed.

Apprentices attend drawing schools.

All the apprentices at these works attend the Sunday drawing schools, of which the proprietor informed us that there were six in Zurich. They also attend the evening drawing classes of the Gewerbe School—the highest school of drawing open to the public. Here are classes in figure-drawing from the life, for advanced students. The teaching in all these schools and classes is free. His own apprentices have profited considerably by the instruction in drawing received in the schools, and he applies their knowledge to practical designing, which is taught at his works. He pointed to several castings in terra-cotta which had been designed and modelled by apprentices, who had obtained their knowledge of art at the free drawing schools.

PAPER MILL ON THE RIVER SIHL, NEAR ZURICH.

Paper mill at Zurich.

Among the industries of Zurich visited by the Commissioners, was a large paper mill, employing 300 workpeople, of whom 200 were women.

Power is supplied by three turbine wheels with a total of 490 horse-power.

The paper, made from a compound of coarse rags, wood pulp, and loading materials, and which is used for newspapers and books, is almost all exported.

The regular hours are 11 per day, but certain machines which run day and night are tended by two shifts of men. No women are allowed to work at night, nor beyond 11 hours a day.

The machinery seemed to be in perfect order and doing excellent work. The men and women appeared to be intelligent, well fed, and as quick and strong as English workpeople in like employment.

TOWN WATER-WHEELS, ZURICH.

Turbines at Zurich.

On the banks of the River Limmat, below the lake of Zurich, a weir has been constructed, and a large turbine house erected by the town. The house contains six turbine wheels of 100 horse-power each, and there is room for three or four more. There is a fall of from 2·60 to 2·80 metres of water to each wheel.

All the turbines are geared to a long main shaft which runs the length of the building, and there are indicators on a raised platform, for registering the pressure of water on the wheels, and the height of the water in the lake.

The turbines and machinery, which are thoroughly well finished, have been constructed by Messrs. Escher, Wyss, & Co., of Zurich.

Chiefly used to pump water for town supply.

The chief use of these wheels is to pump water from the lake to reservoirs on the hill for the supply of the town; but, as there is much more power than is required for this purpose, the authorities are supplying power to neighbouring factories, and transmitting it more than half a mile by wire ropes carried on a lofty scaffolding along the banks of the river. Several factories and workshops, including the weaving school, obtain power in this manner.

Land is sold at a set price per yard, which includes a specified amount of motive power for machinery; while, for all indicated power used in excess of the stipulated quantity, a charge is made of 15 centimes per horse-power per hour.

Experiments in electric lighting.

Some important experiments in electric lighting have been carried on by means of power supplied by the town turbines. The railway station and the public square adjoining have thus been lighted by electricity, and a project is on foot for lighting up the whole town by these means. The extensive utilisation of water-power here indicated, suggests an important future for this great natural resource, in the hands of so enterprising and scientific a people.

Conversations.—Education in Switzerland.

Conversations with Swiss manufacturers and others.

In the towns visited in Switzerland, there was no difference of opinion as to the importance attached to education by all classes. The greatest zeal for education is, undoubtedly, among the poor. It was stated by a gentleman of position that, in seeking the support of the people for election to public offices, candidates were usually profuse in their promises to be economical with the money of the ratepayers, and to cut down the expenses in all public departments. But no candidate dared offer to cut down the expenditure upon schools. The danger in Switzerland was in the opposite direction, and promises of lavish expenditure upon schools were always received with favour by the poorest of the ratepayers.

Primary schools, Basle.

In the city of Basle we were taken by Dr. Hagenbach-Bischoff, a professor of the University, over two new schools—a secondary school for boys of from 10 to 14, and a primary and secondary school for girls. Both were commodious and handsome to a degree not to be found in municipal schools in England. The boys' school was for 600, and, without land, was to cost 20,000*l*. The girls' school was similar in character. The

wide and lofty corridors, and the extensive space allowed to each child in the class-rooms, made it easy to see how so large a sum as 33*l.* per head had been spent.

The schools in Basle are free.

School expenditure is not opposed by the poor of Basle.

A large merchant and banker in Basle informed the Commissioners that there is a small party in Basle which protests against unnecessary expenditure upon school buildings. He had never heard a murmur against the expensiveness of the schools until recently. The buildings had become more and more costly and luxurious, at a time when the trade of the city was depressed, and it was ont his accounts only that objections had been raised. Considering that the education was free and that the entire cost had to come out of rates, paid mainly by the rich, it might seem easy to raise a prejudice against costly buildings. But in reality it required much courage to oppose the schools. In this free country, where the power was centred in the democracy, education was considered by the rich as their safeguard, and by the poor as their most valuable heritage.

"The poor are all in favour of good schools; nay, so earnest are they upon the question, that they are determined that their schools shall be the best in the world. It is considered disloyal to oppose this resolve."

School attendance, Zurich.

We were informed by Dr. Zollinger, President of the Council of Education for the Canton Zurich, that in the elementary schools of the Canton, 95 per cent. of the children on the registers are in average attendance. (In England and Wales in 1882 the per-centage was 72.) In the class-rooms of Swiss schools it is the rule to allow three square metres of floor space and 27 cubic metres of room capacity to every child.

Expenditure half met by State grant in poor communes.

In order to secure uniform efficiency in school buildings, half the expenditure is granted by the State in poor districts, the means of a commune being ascertained by the official tax returns. This provision is taken advantage of to a very small extent, and in 1881 the total grants to poor districts in the Canton only amounted to 1,440*l.*

Money is lent for school buildings at 4 per cent. per annum, which covers interest and repayment of the principal in a specified term of years.

It is Dr. Zollinger's experience that there is nothing on which all classes of Swiss so cheerfully spend their money as upon schools.

Opinions of all classes respecting school expenditure.

The Commissioners took advantage of all opportunities of eliciting the opinions of commercial men and capitalists upon the educational condition of the country, and upon the wisdom of the large expenditure upon schools. We append some conversations and opinions from notes taken at the time. A large employer stated that the primary school gave sound instruction, so far as it went, and that inspection secured efficiency. He was of opinion that the expenditure upon buildings during recent years had

been excessive, but he should not dream of making any public opposition to it, and he did not know of any rich men who had either agitated against the expenditure, or were prepared to do so. When it was suggested that the poor might agitate against it, he laughed at the idea. "In Switzerland," said he, "the poor "are not likely to agitate against a tax of which they get the "benefit without having anything to pay."

In order better to understand the position of the people of Switzerland with regard to payment for education, a few words on taxation may be useful.

Taxation, Switzerland.

Taxation in Switzerland is nearly all direct; the indirect taxes are few and comparatively unimportant. Property is assessed and pays an annual tax to the State, and to the town or commune. Income is also assessed, and upon it is paid an annual tax to the State, the town, and the Canton.

Workmen also pay taxes.

The rate of taxation increases with the amount of the property or income taxed, on the principle that the largest proportion of the tax should be paid by those who are best able to bear it. Workmen pay taxes upon incomes of 24*l.* a year, but we were informed that an agitation is on foot for exempting incomes of not more than 40*l.* a year. The promoters of this movement argue that every man should at least be allowed the means of a bare livelihood before taxation begins, and that to tax incomes under 40*l.* a year is equivalent to depriving the body of its necessary sustenance. The opponents of the measure argue that if any persons are relieved from the obligation of paying taxes, they should at the same time be deprived of the franchise, on the ground that representation without taxation is dangerous.

Payment of poll-tax confers suffrage.

In this country of universal suffrage, the payment of a poll-tax of three francs a year, entitles a man to vote for a representative in the National Confederation. We were informed that thousands of voters pay this tax and no other. The labourer without realised property is practically exempt from taxation in Switzerland, but his vote at an election is equal to that of the wealthiest landowner.

All property is taxed.

All property, real and personal, is taxed, even to a pianoforte or a watch. There are, however, exemptions in the cases of widows and orphans, whose property under the value of 200*l.* is not taxed.

In conversations with employers and capitalists, complaint was often made that, although they have to bear almost the entire burden of taxation, they are altogether out-voted in the spending of the money which they raise.

Reasons for liberal expenditure on schools.

At one time we were told that the great body of the ratepayers are actuated by two motives, in voting for expensive schools —(1) that their children may obtain a first-rate education free; (2) that employment may thus be provided for the artizans themselves, in the erection of the buildings. As this statement was made by a gentleman of importance, we took pains to obtain

evidence relating to the same question from other sources. We were unable to ascertain that the great mass of the ratepayers show class-selfishness by confining the expenditure to elementary schools. The voters are just as lavish in their expenditure on higher schools, which the poor have not the opportunity of attending, and which are used mainly by the rich, as upon the elementary schools attended by their own children. If, therefore, they dip freely into the pockets of the rich taxpayers, in order to provide good schools for the poor, they are equally ready, from the same source, to provide good schools for the rich.

Expenditure mainly devoted to school building.

As to expenditure lavished on buildings in order to find employment for the artizans, we did not receive any evidence with regard to other buildings than schools. We did not hear of cheap places of amusement, such as theatres, built for the poor out of the rates. In a very influential company in Zurich it was remarked to us that "the people spend so much on schools that they have nothing left for the theatre." It may, therefore, be reasonably assumed that there is no serious ground for the charge that the poorer people consciously dispense for their own profit, taxes which come out of the pockets of others.

Why wealthier classes sanction this expenditure.

The richer classes feel that upon every question they can be out-voted, and they are therefore anxious for the well-being of the people by whom they are surrounded, if only to ensure their own comfort and safety. Nothing so much reconciles employers and capitalists to the great expenditure upon schools, as the expectation that in them those who have political power will learn wisdom and patriotism. "Let us educate our masters" is the motto of many Swiss capitalists.

Value of certain technical schools not so much recognised.

In conversing with scientific men and manufacturers in Basle and Zurich, we did not find so strong a belief in the importance of technical schools for special industries, as in France and in some parts of Germany.

Such schools not much encouraged in Switzerland.

An opinion was generally expressed that an industry is best promoted by a separation of theory and practice, the school for theory, the workshop or factory for practice. Hence, with few exceptions, purely technical schools with workshops have not been established in Switzerland. But it was claimed that the scientific teaching of their schools was as good or better than that of the schools in other countries more fully organised for special industries, and that in supplying the basis of all technical education, viz., 'a thorough general and scientific education, no country has made greater sacrifices than Switzerland.

Influence of the Zurich Polytechnic on manufactures.

To illustrate the influence of the Polytechnic at Zurich upon one branch of chemical manufactures, it was stated by one of the most eminent and experienced of the professors, a gentleman thoroughly familiar with England, that the colour

manufactures of Switzerland owe their success, if not their origin, to the Polytechnic School. In support of this assertion, the following figures were given as to the value of the coal tar manufactures of the previous year in various countries:—

	£
England	500,000
France	300,000
Switzerland	300,000
Germany	1,600,000

Swiss have to import their raw materials.

So far as Switzerland is concerned, nearly the whole of the raw and semi-raw materials for the above products had been imported, and many of them from England. The products had been very largely exported to foreign markets. In the making of these dyes only one firm in England had succeeded thoroughly; most of the others had groped in the dark, without scientific knowledge to guide them. In the German works were trained chemists as competent to take up new work as old. Switzerland had taken a lead by means of the higher chemical knowledge imparted to students in the laboratory, and she had supplied men for works at home and abroad, who in the dyeing industry alone had repaid, ten times over, the entire cost of the Polytechnic.

Technical education the means of attracting capital to the country.

When there was a movement in the Federal Council for lessening the grant to the chemical department of the Polytechnic, it was shown by undoubted evidence that within a few years the chemical laboratories had been the direct means of bringing capital to the country to the extent of millions of pounds sterling, and that their usefulness was crippled for want of better accommodation. The movement for lowering the grant was defeated, and a proposal was carried for the expenditure of 50,000*l.* upon a new laboratory.

Employers in Switzerland stated that it was only by the greatest economy, and an attention to detail, which English manufacturers would not trouble themselves with, that Switzerland could face the competition of England and other foreign countries.

Taxation bears heavily on manufacturers.

It was affirmed that, whilst the poor are more lightly taxed, factory occupiers and manufacturers are much more heavily taxed than in England. With this heavy taxation, and the physical disadvantages of Switzerland, without a mine, canal, or navigable river, it was impossible for large fortunes to be rapidly realised, as had been the case in England. One firm of cotton spinners stated that they pay 1*d.* per lb. more for the carriage of their raw cotton than their Lancashire rivals, and have to bear a heavier cost in the transport of their goods to market.

Cotton Spinning and Weaving.—The Rhine Provinces.

Cotton spinning and weaving. The Rhine provinces.

The cotton factories of the Rhine provinces visited by the Commissioners, may be taken as fairly representing the better factories of Germany generally. In the ordinary operations of cotton spinning and weaving, it was not claimed that any superiority of one factory over another was due to the technical education either of workmen, foremen, or employers. In ordinary qualities, the conditions relied upon for success are the same as those of England, viz., good machinery, economy in management and motive power, and the maximum of production for the wages paid. In specialities, where the margin is greater, proportionate attention is given, as in England, to such matters as influence the value of the yarn or goods produced.

English machinery.

In one large factory which we visited, containing nearly 70,000 spindles and 800 looms, we were informed that all the spinning and weaving machinery, and also the engines, were made in England. The director stated unhesitatingly that he considers English machinery the best of any that he has seen. All the appointments of the factory were modern and well arranged, the machinery seemed to be in good order, and coal is almost as cheap as in Lancashire.

Hours of labour.

The working hours of the operatives are 12 per day, beginning at 6 in the morning and continuing until 7.30 in the evening, with three breaks for meals, viz., from 8 to 8.15 for breakfast, 12 to 1 for dinner, and from 4 to 4.15 for tea.

At the time of our visit, the "hands" were taking their afternoon meal, which consisted mainly of coffee and bread, in some instances with radishes and spring onions. The coffee was made on the spot, boiling water (obtained in the workrooms) being poured upon ground coffee brought by the workpeople.

Wages.

Wages are paid as in England, mainly by piece. Carders earn from 1*s.* 10*d.* to 2*s.* per day, reelers and warpers about 12*s.* per week. Weavers mind from 1 to 4 looms each, and the best earn up to 18*s.* per week.

A new factory.

In the same locality we were taken over a cotton spinning factory, entirely new, and only started a few months before. The proprietor, who spoke English fluently, conducted us over the premises, and evidently knew his business thoroughly. He informed us that before ordering new machinery he visited the machine shops and the new mills in Alsace, and afterwards all the leading English makers and the best mills in Lancashire, particularly in the Bolton district. In examining the machinery of different makers, he selected what he considered best, irrespective of price or country, and several makers are represented. He showed us carding engines and drawing machinery, some English and some Alsatian, working side by side. He considered that in many respects Alsatian machinery is as good as English.

In striking contrast with most of the cotton factories visited, all the spinning and twisting were on the ring (Rabbeth) principle Mules had been entirely dispensed with. The premises throughout were in first rate order; the rooms lofty, well ventilated, and fire-proof. The upstairs rooms were all elaborately tiled, and the tiling of the "gates" and alleys was done in ornamental variegated patterns, as handsome as in public buildings in England. Such instances of ornamentation in mill fittings were rarely observed by us, but they showed that "mill pride" is not the monopoly of the successful Lancashire cotton master.

Cotton trade of Germany and Lancashire compared.

It is clear that our rivals have possessed themselves outwardly of all the advantages and excellences which have been the growth of English inventiveness and enterprise during the last generation. To the casual observer strolling from room to room, and watching the varying processes, from the soft white sliver to the "built up" cop of yarn, there would not appear to be a very appreciable difference between a German and a Lancashire factory. The raw material, machinery, and appointments are equal in both cases. In general appearance the operatives do not compare unfavourably with those of Lancashire. With 72 hours for work per week, as against 56½, and with wages considerably lower than in Lancashire, the advantage in cheapness of production seems to be altogether on the side of the German spinners, and would lead to the inference that they would keep English yarns out of their own and undersell them in neutral markets. Such, however, is not the case. The director of one of these factories accompanied us to the premises of a neighbouring cotton manufacturer not more than 50 yards away. At these works there are no spinning operations carried on, and the proprietor informed us that he buys all the yarn that he weaves. His leading quality is extensively spun by his friend and neighbour across the way, and by other local spinners, to whose yarn he always gives the preference, as against a foreign, one when they can offer it at the same price. He admitted, however, that he is compelled to buy most of his yarns from England, because, in spite of the import duty, and the carriage and packing, the English yarns are cheaper than the yarns spun by his neighbours, or any of the German spinners.

Reasons for cheap production in Lancashire.

It is clear from such evidence that low priced labour is not the only important factor in cheap production. Lancashire operatives have been, as it were, bred to the work, and they thoroughly understand it. Division of labour in every operation is carried to the minutest detail; the operatives have been stimulated by piece-work, by constant competition among themselves, and by the attractions of the "divi" or bonus, to bend their whole energies to the production of the greatest possible quantity of work in the time allotted, so that they may earn the highest possible wages. The voluntary high-pressure exertion of the operatives is unrivalled elsewhere. Each employer concentrates his energies on one or two counts or qualities, and some of the largest factories in Lancashire run from year to year, almost without changing a machine. In no country on the Continent

is there the same concentration and organisation of the cotton industry, and the same energy on the part of employers and employed, as there is in Lancashire; hence its strong position in spite of apparent disadvantages. The fact, however, cannot be disputed, that in the Rhine provinces and other parts of Germany the example of England in organisation as well as in machinery is being closely followed, with the natural consequence that the cotton industry is rapidly extending, while there is a growing increase in the efficiency of the workpeople.

CALICO-PRINTING.—ALSACE.

General characteristics of Alsatian calico-printing.

There are certain features of the calico-printing industry of Alsace, which render comparison with the same industry in England somewhat difficult. From the earliest introduction of calico-printing, the Alsatians have been celebrated for the beauty and permanent character of their colours, and especially for the artistic taste displayed in their designs. In both of these very important kinds of excellence the Alsatian calico-printers have taken a leading position in the world, and they compete successfully with their English rivals, not only in neutral markets, but also in our own. While in England, speaking broadly, the calico-printers have chiefly devoted their attention to the class of goods suitable for the million, and have organised their works for the production of large quantities of prints at a cheap price, the Alsatian manufacturers have given special attention to the production of more elaborate goods, such as imitation tapestries, cretonnes, furnitures, and other highly finished and costly productions, many of which can, as yet, only be manufactured by means of block printing. Some of the wealthiest and most enterprising of the Alsatian calico-printers, whose works we visited, while developing to the highest point of efficiency machine printing similar to that of England, still retain their specialities of hand-block printing. It is maintained that, although for the ordinary run of patterns hand printing has no chance in competition with the machine products, yet for work of complicated design and colour, which can nevertheless command its price, hand work flourishes in spite of its greater cost. One of the tapestry designs which we saw in progress, required as many as 200 blocks for the complete display of the design and colouring, and the workpeople engaged in these operations were trained to a high pitch of precision and delicacy of hand. Among the varied and beautiful patterns in course of preparation at one of the largest establishments, were some reproductions of pictures of children from the Christmas books of Kate Greenaway, which were being printed in fancy colours for dresses to be exported, mainly to France, England, and America.

Hand-block printing.

So far as we could ascertain, the leading designs come from Paris, although it is claimed that no district sends so many young men to Paris to be trained for designers as Alsace. Some of the large houses employ designers, who work in Paris; others buy designs submitted by Paris designers; and again others employ Parisian designers at their own works. In the use of Parisian designs the procedure is similar to that of English printers, but it is said that many more designers are trained in Alsace than in England, and that the proportion of designers to the quantity of work done is very much greater than in England. This must necessarily be the case in a branch of industry which depends for its success more upon novelty and originality than upon cheapness and extent of production. Designs come from Paris.

In the Mulhouse print-works the hours of labour are 11 per day, against 10 hours in Lancashire, and the wages in Mulhouse are lower. It must be remembered, however, that in Alsace the plain calicoes are not so cheap as in England; coal and machinery are more costly, and in case of shipment, carriage is more expensive. If the question of competition were considered merely in relation to hours of labour, wages, and the other conditions above indicated, the advantage would appear to be with the Alsatians. As a matter of fact the branch of the trade which has been so successfully conducted by the Alsatians, is that in which highly artistic design, skilled labour, and expensive processes are necessary, whereas in England, with higher wages and shorter hours, the less complicated branch of the trade has been most extensively developed. It must not, however, be assumed that these general characteristics of English and Alsatian trade prevail universally in each country. There are individual firms in Alsace who make the same classes of goods for the million as are made in England, and there are English firms who, it is admitted, equal the Alsatians in the best kinds of machine printing. It may here be stated that one of the largest of these English firms, whose prints have attained a high degree of celebrity, informed the Commissioners that their leading designers were Frenchmen employed in Paris, and that the head of their chemical department was also a Frenchman. Labour, fuel, cost of production.

It is a noteworthy fact that, in nearly every instance, the employers and foremen of the establishments we visited, were men of high attainments. A great proportion of them speak English, and, from frequent intercourse with English machine makers and printers, they are able to obtain accurate information on all matters relating to the development of their industry. Foremen are highly educated.

In every establishment there were trained chemists, some of whom were workmen who had gone through courses at the School of Chemistry in the town, or were at present attending classes during the evening. The employers themselves, who are practically interested in the school, take the greatest pains to promote its efficiency, constantly offering suggestions as to Trained chemists employed.

how the chemical instruction may be made systematic and practical, so as to be really useful to the industries of the district. They even open their works to the students of the school, who come at stated times in company with their professors, and are shown the manufacturing processes.

Opportunities for instruction at Mulhouse.

The interest of the large employers is not, however, by any means confined to the technical and scientific acquirements of their employés, and to the means by which such knowledge may be obtained. The opportunities afforded for instruction in art have long been of an extended and praiseworthy character; but not content with agencies in advance of any that may be found in any English town of the same population (64,000), the public-spirited inhabitants of Mulhouse are building, not, as is so usual on the continent, out of State and municipal funds, but by private subscription, a new art gallery and museum for the study of Fine Art and Design, at a cost, we were told, of nearly 20,000*l*.

Employers contribute to local museums.

Moreover, employers vie with each other in their contributions to the unrivalled Trade Museum of the town, of designs, patterns, and choice examples of weaving and printing. The Museum is open to the public, as well as to all connected with the calico-printing industry, and the benefactions to the Industrial Society are among the most remarkable illustrations of public spirit that we have witnessed.

Young men attend drawing schools.

Whenever the question was asked, the Commissioners found that the young men engaged in the various works attended the Drawing Schools of the town, and it is but reasonable to suppose that, as they are in constant contact with varied and beautiful designs, and are daily engaged in manipulating them in the different stages of their employment, they will bring to their Art instruction a quick perception of its useful applications, and will display in their industrial occupation a genuine and cultivated sense of beauty.

Engraving School.

We found among the engravers employed in the various works, notable instances of young men who had received their entire instruction in the Engraving School, which is under the patronage and support of the Industrial Society. In fact every inducement is given to the poorest and humblest of the boys in the elementary schools, who show talent or proficiency in drawing, to attend first the Drawing School, and afterwards the Engraving School, where, without any cost to their parents, they are trained in all the processes of engraving for the calico-printer, and are afterwards at liberty to sell their highly skilled labour at the best advantage, either in their own town or elsewhere.

Industrial partnership.

In some of the works the principle of industrial partnerships—according to which workmen are allowed to participate in the profits—has been introduced with considerable success. The Commissioners were furnished with interesting information on this head, at the dyeing, bleaching, and calico-printing works of

Messrs. Schæffer, Lalance, & Co., Dornach. The firm which now employs 1,200 operatives, was founded by Mr Schæffer. Very much is done for the welfare of the men by means of savings banks, sick clubs, co-operative societies, &c., and each workman participates in the profits of the concern. The experiment is said to have been successful in promoting the general prosperity of the firm, both of employers and employed. Workmen who used to be irregular in their attendance and given to change by migration, are now fixed to the place, owing to the competition for admission to the works it has been found to raise the general standard of efficiency with the natural result of good management and friendly feeling.

Their system, and the results of the system.

In the interviews of the Commissioners with the leading inhabitants of Mulhouse, there was a general concurrence of testimony to the effect that Mulhouse owes its commercial prosperity, first, to the commercial and scientific enterprise of its manufacturers, secondly, to the absence of trade jealousies, and, lastly, to the public spirit of the citizens in promoting the general education and the improvement of the town. We have elsewhere given the history and aims of the Industrial Society, which is admitted on all hands as the chief factor in raising the wages and improving the advancement of the commerce and prosperity of the town. For fifty years past it has brought many men of wealth to patriotic objects, and during all that time it has been the centre of educational zeal, philanthropy and improvement, founding schools and circulating valuable and useful information throughout the trade, raising and contributing large sums of money for objects of public usefulness, and watching all that was likely to promote the welfare of others.

Effect of the transfer of Alsace to Germany.

It was stated to us that the manufacturers of Mulhouse, in common with the manufacturers in the other parts of Alsace, had suffered very seriously from the transfer of their province to Germany. Before the war of 1870, Mulhouse contributed the chief supply of imprimé prints to France, and the famed calicoes exported from France to all parts of the world were very largely the products of Mulhouse. After the German annexation, all commodities coming from Alsace were subjected to a serious import duty, which, to a great extent, shut out the Alsatian products, and gave a great impetus to the trade of Rouen.

Trade with Germany had to be sought.

There was no corresponding demand in Germany at that time for the high-class goods which had been made in Alsace, and consequently many of the printers were compelled to turn their attention to the German trade in a lower class of goods, thus for a while lessening the competition in the high-class articles. But in spite of the import-duty, and the consequent protection of the French calico-printers at Rouen and elsewhere, the Mulhouse printers are now able to overcome the protective duties of France

and to compete so successfully with their French rivals that the volume of trade with that country is now greater than before the war. The influence of these enterprising manufacturers has been felt in an equal degree in Germany; the annexation injured the sale of Alsatian goods in French markets, but it gradually opened up to them new markets in Germany, not only for the sale of their finished products, but also for the advantageous purchase of the colours and other chemicals used in their manufacture. The result is that many of the German calico-printers in other parts of the Empire have been compelled either to increase the efficiency of their establishments or to succumb to a competition from which there was no escape.

Exports to other countries from Alsace.

The excellence of Alsatian work may be inferred from the statement of one of the largest firms in Mulhouse, that of their entire products fully 80 per cent. are exported, and that mostly to France, America, and England.

Hosiery and Glove Trades.—Saxony.

Hosiery and glove trade of Saxony.

The hosiery and glove trades of Saxony are rapidly growing in extent and importance, and are largely contributing to the prosperity of the State. The Commissioners visited some of the more important works and had interviews with the leading representatives of these industries. We were informed by Mr. Felkin, the English representative of the Nottingham Manufacturing Company, and the author of the interesting work entitled "Technical Education in a Saxon Town," that "in the "hosiery trade there are 64 firms in Chemnitz itself." "Of "these, 26 are glovemakers, and the remaining 38, hosiery manu- "facturers; besides a large number of other firms in Stollberg, "Limbach, Burgstadt, and other towns in the immediate vicinity."

Development of hosiery trade.

Mr. Felkin states that "the development of this industry has "been most remarkable, and has taken place almost entirely "within the last 30 years, and to such an extent that Chemnitz "has proved itself a formidable and successful competitor to "Nottingham, not only in the United States of America, and "all other export markets, but in the English market itself. "The quantities of Saxon goods, both hosiery and gloves, poured "into the London market, would surprise some Nottingham "manufacturers, and astonish still more the stocking makers "and their leaders." "The manufacturers are now bestirring "themselves to obtain a footing in the English colonial market, "a trade from which they have hitherto been shut out, except "in so far as they have reached it through the large London "houses." As giving a somewhat striking instance of the enterprise of the manufacturers, and of the activity of the local Chamber of Commerce in pushing the trade of the town, he states that a Chemnitz gentleman, formerly resident for some time in Nottingham, had been sent out by the Chamber of Commerce,

Enterprise of the Chemnitz manufacturers.

first to the Sydney Exhibition, and afterwards to the one at Melbourne, so that he might not only superintend the Saxon exhibits, but show samples of goods, collect information as to the wants of the colonists, open accounts, and so lead to a direct business between Chemnitz and the Australian Colonies.

The report of the American Consul at Chemnitz, for the year ending September 30th, 1883, confirms in a remarkable manner the evidence of the activity of the manufacturers and of the Chamber of Commerce in pushing their trade in distant markets. The total trade of manufactured goods exported by this comparatively small district to America for last year represented a value of 1,773,502*l.*, of which 953,194*l.* were for hosiery and 414,585*l.* for gloves, or a total in these two commodities of 1,367,779*l.*

Transfer of the glove trade from Nottingham to Chemnitz.

As for the glove trade, Mr. Felkin states in the work already quoted, that "it may be said to have been transferred from "Nottingham to Chemnitz." "The loss of the glove trade to "Nottingham is an example of the way in which England is being "robbed in detail of her industrial supremacy," and he proceeds to describe the rapid transition in the hosiery trade from being a small industry, carried on at the houses of the workers upon wooden hand frames, to a factory industry with iron frames running by power, as in our own great factories. The best English machinery has "gradually spread itself all over the country." "The "wooden frames are dying out, and large factories have been built "and fitted with power machinery of different systems and of "the most modern construction. This change has placed the "industry on a par with that of Nottingham, and the establish-"ment at the same time of the Technical School at Limbach, has "enabled a class of young men to be educated for the trade, who "have been made acquainted with modern machinery and "systems of manufacturing, and have been carefully trained for "various situations as foremen, managers, clerks, and takers-in. "Meanwhile, too, the sons of manufacturers have been preparing "themselves to take their fathers' places. These younger men "now coming into the trade are, thanks to this technical edu-"cation, of a different stamp from those of 20 years ago, and "are already exercising a marked influence on the development "of the trade."

English machinery employed.

Machinery the same as in the best English factories.

The Commissioners found, in the leading hosiery works, the same class of machinery, the same material, and the same general organization, as are to be met with in the leading hosiery factories in England. Full fashioned stockings and socks were being woven on the newest machinery, and circular goods were also being knitted in lengths and cut into shape and sewn by machinery also. The heavy frames are usually minded by men; the operations of cutting, sewing, shaping, pressing, and making up, are performed by girls and young women. The operatives work from 11 to 12 hours a day, including meals, and mostly by piece.

Cotton stocking making is the chief industry of Chemnitz.

We were informed that the making of cotton stockings largely predominates over those of Angola, wool, or other material, and that the cotton yarn, although to a large extent supplied by firms in Saxony, is also bought in large quantities from Switzerland. The import of cotton yarn from England is comparatively small. We were told that the output of one firm is 4,000 dozen pairs of stockings per week, which are chiefly exported to America; another large firm informed us that at least half the stockings they made are exported to England.

Glove factories are very prosperous.

In the glove factories which we visited, there were evident signs of prosperity in the substantial and almost luxurious character of the buildings and internal arrangements. The gloves are almost exclusively made of cotton material spun to fine counts, which, in the first instance, is woven into a piece, and is then stamped or otherwise cut into the required shapes, a considerable number being acted upon at once, by machinery. The sewing of the gloves is also done by machine, this process, as are also most of the others, being carried out by girls sitting at tables to which the machines are fixed.

Piece work.

Most of the work is done by piece, and the best of the women earn what are considered fair wages for Saxony, namely, an average of about 9*s.* per week.

Swiss cotton yarn preferred.

The proprietor of one of the factories informed us that he manufactures 5,000 dozen pairs of gloves per week, and that he buys most of his cotton yarn, which is fine in quality and counts, and is beautifully managed in the spinning, from Switzerland. As a matter of fact, we found, in more than one instance, that these Chemnitz manufacturers were receiving their yarns from the cotton mills in Switzerland which the Commissioners had visited.

Workpeople do not attend technical schools.

We did not ascertain, in any of these hosiery or glove factories, that the workmen or women have attended the technical schools in any number. The employers and sons of employers, and many of the foremen, have supplemented a sound general education, and in many instances a high scientific education, by an apprenticeship in the factory, and, what is equally important, by frequent visits to other countries, and by inspections of the newest machinery, in the towns where it is made or worked.

Limbach Hosiery School.

That they have great faith in the importance of special schools for hosiery is evidenced by the establishment of the school, at Limbach that has been built mainly by subscriptions, at a cost of 2,000*l.*, where a complete course of technical instruction is imparted. The enterprising manufacturers see that changes are imminent. Not only has the hosiery trade advanced within a recent period from a home to a factory industry (from hand to power), but it is now turning from a plain trade to a fancy season one, like that of England. Mr. Felkin, in his book, expressing the views of the promoters of these undertakings, says, "The manufacturer of the future will have to make fancy goods

" from power machinery, to suit a season's trade, and to catch " the passing fashion of the day. Whoever does this best and " cheapest, whether at Nottingham, Chemmitz, or Troyes, will " get the trade. Nottingham, which has hitherto had the " supremacy, now complains that Chemnitz is taking the trade " away, owing to the cheapness of Saxon labour. This, no " doubt, is the main cause, but is it the only one? Cheap labour " may enable the Chemnitzers to get the trade, but cheap labour " alone, with the existing outlook, will not enable them to keep " it, for without trained intelligence and technical knowledge on " the part of the workmen, and enterprise among the manu- " facturers, it would soon revert to them again." Mr. Felkin thus continues, "In future, manufacturers and their responsible men " will require a far more extended technical training than in the " past, and if labour is cheap in Saxony, and the trade there has " its technical school, educating young men, how necessary it is " that the people of Nottingham, fighting against these odds, " should strain every nerve, and omit no means to hold their " own."

Influence of hours and wages on cost of production.

In considering the influence of hours and wages on the cost of production in the several countries visited by the Commissioners, the testimony, speaking generally, of experienced persons has been to the effect that the better and more sustaining food of English operatives, which their higher wages enable them to procure, and their larger amount of leisure and rest, arising from their shorter hours of labour, have so far increased their physical strength and energy as to enable them, in conjunction with other advantages, to produce the various kinds of work as cheaply as their more poorly paid competitors in other countries. The evidence obtained among the representatives of the hosiery and glove trades, and our own observations in the factories generally, hardly bore out this view, so far as Chemnitz is concerned. The workpeople generally seemed to be in good circumstances and healthy. The hundreds of girls who tended the machines, or sat at the tables, in the different factories, doing varied work, were all well-dressed and clean and tidy. Still, comparing them with the same class of girls engaged in similar work in Nottingham, the palm would be given to the girls of the English town. With the factory girls of Yorkshire and Lancashire a comparison is less easily made, because the hosiery and glove trades are cleaner than those of wool and cotton; yet, in healthy appearance, and particularly in dress, the girls of Chemnitz, with 10 to 15 hours per week more work, and with wages very much lower, were not far behind those of the two great English counties. It is evident that the condition of the workpeople in Chemnitz is such as to enable them to obtain good food and clothing, nor do their hours of labour overtax their strength so as to materially lessen their capacity for work.

Workpeople appeared healthy and well dressed.

Employm- for bot

In judging of the condition of people engaged in any given industry, it is important to know something of the general

is plentiful in Chemnitz.

sources of income available for families. Cheap production in any locality is largely promoted by a diversity of trades, giving employment to all classes of labour. The most prosperous of manufacturing towns in all countries are those which secure a "balance of trades," adjusted to meet the natural local supply of "hands." In such cases it is generally found that a minimum rate of wages is paid in each industry, with a maximum of efficiency. It was explained to us that Chemnitz affords a good illustration of a town favourably organized as to its balance and diversity of trades. The locomotive engine works of the State, and the large and small works for engineering and the building of general machinery, numbering about 60, provide employment for the skilled male population at fair wages; the cotton, woollen, worsted, hosiery, and glove industries, provide suitable employment for the women and children. In periods of depression it is seldom that all the industries are slack at the same time, and thus the family incomes suffer less from extreme fluctuations than in districts dependent only on one industry. In ordinary times, although in a family the wages of each individual may not be high, yet, where there are three or four workers, the men and boys at the machine shops, the women and children at the spinning and weaving and hosiery factories, the aggregate earnings enable the families to live respectably, and to put by a fair surplus for a rainy day.

Standard of education is exceptionally high.

It must also be borne in mind that the standard of education among the poorest is exceptionally high in Chemnitz, with a proportionate standard of decency among the same class; and as there is very little time wasted through intemperance, even the poorest attend to their work with greater regularity than is the case in England, and thus their average of wages, although apparently at a lower rate per day, may be higher per month and per year than the wages of the same classes in England.

The nature of the work is healthy.

The nature of the work in these industries not being of an exhausting character, and the rooms generally being well-ventilated and free from dust, may largely account for the fact that the women working 10½ hours per day in these industries, seemed healthier and more robust than the generality of women in the cotton and woollen factories which we visited in other parts of Germany and France. Their tidy and respectable appearance may also be partly due to the influence of employers, who doubtless encourage tidiness.

Strong position of the trade not due to technical education.

If, therefore, the hosiery and glove manufacturers of Chemnitz are taking a stronger position than that of their English rivals, this appears to be due to the conditions above indicated rather than to the special influence of any technical education which they receive, admitting at the same time, its great importance as a factor in the future development of the hosiery industry.

Complaint of glove manufacturer.

One of the large glove manufacturers gave forcible expression to complaints, which English rivals may accept as crumbs of consolation, as indicating that all is not plain sailing, even

in Saxony. He said that eleven years ago, in 1871, after the Franco-German war, the trade extended altogether beyond the legitimate requirements of the markets. Money was made rapidly, and much of it was spent in building and extending factories and buying new machinery. The consequence was that much of this money had been lost. At present there was more machinery than could find employment, and no profit. He stated that two years ago the demand for America was unprecedented. Beginning with the autumn of 1879, and continuing to the spring of 1880, orders without limit were pressed upon him, and raw material advanced at a surprising rate. He was compelled to buy yarns to cover contracts made, when in the spring the demand suddenly stopped, the whole business seemed to collapse, and enormous orders, particularly those from America, were cancelled without any compensation whatever. The result was that he and many others were left with expensive material upon their hands, and since that time the glove trade had not been able to make any real headway.

Wool Industry.—The Rhine Provinces.

Wool industry in the Rhine Provinces.

The Commissioners, accompanied by Mr. W. T. Mulvany, President of the Association of Manufacturers of the Rhine Provinces and Westphalia, and Herr Bueck, the secretary, visited the three large and important factories of Messrs. John Wülfing and Son at Lennep, near Elberfeld. The first of these was a worsted mill, similar to those of Alsace and Roubaix, for the combing and spinning of fine wools, which come mainly from Australia and are bought at the London wool sales.

Hours of work.

The regular hours of work are 12 per day, or 72 per week. When exceptionally busy, they work 13 hours per day, or 78 per week.

Wages.

Wages are paid by piece in nearly every department. In the carding, however, the wages are paid by the day; they average about 7*s.* 6*d.* per week; but the wool is weighed to all the carders, and the output is booked. "Short-timers," between 12 and 14, work from 6 to 8 hours per day, and are paid up to a maximum of 3*s.* per week. Girls and young women engaged in combing and drawing, earn from 7*s.* to 8*s.* per week. Spinners are paid proportionately higher. The wool-sorters were nearly all women, and they are paid about 8*s.* per week.

Heilman's combs seemed to be universally used, and all the combing machinery is from Alsace. The "tops" are backwashed and spun without oil.

In the drawing of the tops, preparatory to spinning, the rubbing process is applied in every operation down to the roving, as we saw in all the worsted mills for fine wools that we have visited on the Continent.

Machinery.

The machinery, which seemed to be in excellent condition, is nearly all from Guebwiller in Alsace. A member of the firm

stated that all the Alsatian machine makers may be relied upon for satisfactory work, judged even by an English standard. English spinning mules are as cheap as any, and in this factory they have two of English make; but, in giving their general order, they wished to alter certain details which the English makers declined to change, and therefore they gave their last order to Alsatian machine makers, who were willing to accommodate them.

Extension of factory.

The most remarkable evidence of the success of this branch of the wool industry, is to be found in the fact that the firm are about to enlarge this factory to the extent of three times its present size and production. At present they run 10,000 spindles and are extending to 30,000 spindles. None of the yarn which is spun here is woven on the premises, but is disposed of to various parts of Germany and to other countries. The firm expect that they will be able to open up a connection for its use in England.

Cottages.

The proprietors of the factories are also large owners of cottages, which are occupied by their workpeople, and usually contain one living room and two bedrooms each, and a garden. We understood that the cottages, including garden, are rented at about 4*l.* per year each.

Co-operative stores.

We also saw a large co-operative store, where the workpeople are supplied with food and clothing of good quality at cost price, after allowing for the expense of management.

Angola, Woollen, and Shoddy Yarns.

Woollen factory, Dalhausen.

We were conveyed about three miles across the country to see a second factory, a large woollen spinning establishment belonging to the same firm, employing from 500 to 600 hands, and situated on the banks of the river Wupper, in a beautiful part of the country, surrounded by wooded hills and homesteads, and fertile and well cultivated land. We were informed that from this point to Barmen, a few miles down the stream, factories are located on the banks of the stream within ten minutes' walk of each other. They seemed almost as numerous as in the manufacturing districts of Lancashire and Yorkshire.

Rapid reconstruction of works.

We had here an opportunity of seeing the effect of a rapid transition from the use of machinery of average efficiency to a full equipment of the newest and most modern. On the first or second of January of this year (1882) the mill was completely gutted by fire, the outer walls only being left undestroyed. It was rebuilt, floored, roofed, furnished with new engines and new machinery, and was *running* before the end of April.

Machinery.

Before renewing their machinery, the heads of the firm visited every important competing district on the Continent and in England. They saw all the newest and most approved machines, and examined all the improvements that could be found at work or suggested by machine makers.

Engines.

For the engines they gave the contract to the Augsburg Engineering Co., whose engines—double-horizontal—it would be difficult to surpass either in finish, steadiness, or economy of working. The mill was driven by ropes from the fly-wheel, communicating with the line shaft in each room, and all the arrangements and connections were working admirably.

Improvements.

It would be improper for us to enter into details as to all the arrangements of the machinery, from the washing of the wool, the extraction of the products from the refuse soapsuds, the mixing of the shoddy, to the carding, spinning, and dyeing of the yarns. We may indicate some of the advantages of a complete renewal of machinery, as explained to us, and which were all the more apparent, because in each instance the space devoted to the machinery was the same as before the fire. The accommodation was prescribed by the four walls of the factory, and all that had happened was the putting in of engines and other machines of the best kind, in each, instance that could be obtained. The whole transformation had been carried out as above stated within less than five months. It was stated that the machinery destroyed was in good condition, capable of years of service, and in every way as valuable as that of their competitors. In one of the most important departments they were now doing as much work with half the number of machines as they had done with those destroyed, and the quality of the work was better. In every other department the increase of production and the benefit in cheapness had been most marked, and their present yarns were everywhere received with decided preference as compared with the old. The new machinery which had produced this remarkable result was nearly all from England.

Safeguards against fire.

The safeguards against any possible fire in the future were very elaborate and complete. All the communications from the passages and staircases were by iron doors. The rooms were supported by iron pillars, the ceilings were covered with corrugated galvanized iron, above this a thick concrete, while the floors themselves were tiled.

Progress on the Continent.

It is reasonable to suppose that, although much of the woollen machinery at work on the Continent may be somewhat antiquated, all new machinery started henceforth will be of the best and most modern character, and all the new mills will be arranged in accordance with the most approved plans that can be suggested by English architects or machine makers. The enterprising Continental firms are becoming rapidly educated by visits to England and by experience such as the above, and no machinery is bought until the intending buyer has seen the best of the kind that he wants in the most modern of English factories. England's material advantages have been greatest in machinery, but they are thus being daily lessened.

Cloth Manufacture.—Spinning and Weaving of Tweeds, Coatings, &c.

Woollen Mill, Daleraue.

We visited a third factory belonging to this enterprising firm, at Daleraue, where we found nearly 600 operatives engaged in the various processes connected with the manufacture of cloth, from the sorting of the raw material to the finished "web" ready for the shop counter.

Chemist for testing dyes.

A chemist is employed for testing dyes, and assorting the colours, but the ordinary dyers have not received any scientific training.

The work of analysing the patterns of cloth, &c., and the sampling of the colours, was being done with great delicacy and expertness by a female, in a room set apart for the purpose. It was explained to us that she prepares the "blends" by first matching and then weighing the selected fibres on a delicate balance, and calculating the proportions required for the various orders.

Designing.

The designs on the cloth were more of a geometrical than of an artistic character. The figures were twills, checks, stripes, and "mixtures," of which many were very effective. One of the younger members of the firm supervised the designing department. He had attended for some years the weaving school at Elberfeld, now discontinued. He stated that he learned a few things there certainly, but he was not impressed by its importance. His best school had been his father's mill, and to a young man in his position a mill must always, in his opinion, be better than a school.

Care in the processes.

It was very evident, in walking through the several departments of the factory, and particularly the weaving and "taking-in" rooms, that the greatest care is exercised in every detail of the business. One of the partners, who takes the general management of this mill, informed us that he sees, many times over, every piece that is woven, and the number of young women employed in looking over and touching up the pieces after leaving the looms, would greatly astonish the majority of manufacturers in England.

Excellence of work.

As to many of the lighter cloths, which were dyed in colours of great variety and delicacy, and of worsted coatings for men's wear, it would be difficult to speak too highly of their excellence. The trade mark and initials of the firm were being stitched on all the pieces, and also the mark of the "burler" through whose hands they had passed.

Markets for goods.

We were informed that the firm send their goods to all parts of the world, and that they have their own branch houses and agencies in different countries [illegible] a large trade direct with South America. One of [illegible] tracts at present in hand was for cloth for the cush[illegible]ges of one of the railways of

the United States. They had obtained this contract in competition with manufacturers in France and England, and it was sufficiently large to keep an important portion of their machinery going for some months.

Competition with England.

The complaint has been frequently made in England that to a large extent we have lost the American trade in cloth goods because of the high tariff, which doubles the cost of such goods when they arrive in New York. The tariff, however, applies to Germany just as it does to England, and, therefore, the difficulty of entering America is the same in the case of each country. The cloth in question was being made from wool that this firm had bought at the wool sales in London. It had been shipped to port, and had made a long railway journey, and had then been carted three or four miles over a hilly country from the railway to the works. After the processes of manufacture, mainly upon English machinery, it was being sent to America, where it had been accepted in preference to English cloth that had competed against it. The preference given to the German cloth was clearly not owing to the tariff, but to the fact that the German material was either better and cheaper, or that it pleased the eye more, than the English cloth.

We found this state of things everywhere prevalent, in certain industries. The French, Alsatians, Swiss, Germans, and Austrians are, in great varieties of goods, such as textiles, fancy goods, &c., competing with the English in neutral markets and also in England. There is something besides cheap labour to account for this in some, at least, of these instances. Our competitors in these commodities are more successful in pleasing their customers, and that is why they get the orders. It is no argument that, because we excel in many things, we have no need to be concerned about those things in which we are being surpassed.

Fair trade.

One of our entertainers, who seemed to be as familiar with England as with his own country, described himself as a free-trader, but was much interested in the discussions on "fair trade" in England. His great wish, and that of all Continental manufacturers, was that England would put on import duties. If England would copy the Continental nations in protecting native industries, his firm would at once double their mills, for then England would be less able to undersell them in the neutral markets. Protection would make everything dearer in England as it had done in Germany, and the cost of production in England would be proportionately increased. His firm do not export to England, neither do they expect to do so, but unfortunately they meet England everywhere, in all parts of the world. England "possesses" the neutral markets, and is always their most serious competitor. "If England would only protect," said our friend, "there would be a fine chance for us;" and he rubbed his hands with glee at the possibility of a consummation, so devoutly to be wished.

WORSTED MANUFACTURE.—ELBERFELD.

Worsted mills, Elberfeld.

In the towns of Barmen and Elberfeld, and in other parts of Germany, as we have explained with regard to Saxony, there are several factories for the making of mixed fabrics similar to those of Bradford. In most of these the yarn is imported from England, and woven on English machinery, but we visited one of the largest establishments in Elberfeld, in which all the operations of manufacturing are conducted, from the sorting and combing of the wool, to the dyeing, finishing, and making up of the pieces.

Comparison with England.

In the wool industry we had few opportunities of comparing foreign factories with those of England, under similar conditions as to machinery and raw material. In this instance the whole of the combing, preparing, and spinning machinery had been imported from Keighley, and the looms were from Keighley and Bradford. The organisation and arrangements of the factory were similar to the leading worsted manufactories in Bradford, and had evidently been copied from them.

Hours.

The operatives work 12 hours a day, and when the firm are busy, the works run overtime. They employ children in the spinning department, between the ages of 12 and 14, but they must attend school for a specified number of hours each day.

Wages.

Contrary to the usual custom in other factories which we visited, we understood that all the combing, drawing, and spinning operatives are paid by day, as is the custom in Bradford. The spinners are paid from 8*s*. to 10*s*. per week, according as they mind—to use the technical expression—two or three sides. The spinning frames each contain 144 spindles. Doffers are paid about 7*s*. per week. Weavers, by piece, earn from 10*s*. to 20*s*. per week.

Products manufactured.

Most of the looms were weaving what are generally known as "Bradford goods," with cotton warps and weft, spun on the flyer frames on the premises. Some were weaving mule-spun fine yarns for all-wool goods, similar to those of Rheims and Roubaix. Most of the weavers tended two looms.

Home dyeing.

In one respect this factory differed from those of Bradford. In the latter town the manufacturer usually sells his pieces to the merchant, who sends them to a professional dyer, to be dyed and "finished," and they are afterwards made up by the merchant and distributed to the shopkeepers, or sold in cases to merchants in other countries. In this instance all the processes of dyeing and finishing are carried out on the premises, and the firm make up their goods for the market. They employ travellers who sell direct to the shopkeepers in Germany and other countries, and in the American and other foreign trades they do their own shipping.

Workpeople.

From such a superficial impression as could be obtained in walking rapidly from one department to another of the works,

there did not appear to be much difference between the general appearance of the workpeople and those of Bradford. Individually, many of the men and women seemed to be exceptionally healthy and strong, but there were many who were undoubtedly below the average of those of competing industries in England.

Complaint was made by the heads of this firm that trade for some time past had been unsatisfactory, but they had kept their machinery employed during the long depression. On being asked why they did not spin the twofold braid yarns imported in such large quantities from England to Elberfeld, and for which their spinning machinery was said to be well adapted, they replied that it was impossible to make braid yarns for the prices accepted by Bradford spinners. Trade depression.

Braid Factory, Barmen.

At Barmen the Commissioners visited a large factory for the manufacture of braid for trimmings, military uniforms, &c. The processes are interesting, and some of the machines are of a somewhat complex character. Braid factory, Barmen.

Upwards of 300 hands are employed, of whom none are children or "short-timers." They begin work at 6 in the morning, continuing until 8 in the evening, with two hours' interval for food, making a total of 12 hours per day. Hours of work.

The ordinary "hands" earn from 8*s*. to 9*s*. per week. The best braid weavers, who weave as many as 60 braids at a time in one loom, earn a maximum of 20*s*. per week. Young men, for plain braids, earn about 15*s*. per week. Nearly all the work is done by piece. Dyers are paid by the day, at 18*s*. to 20*s*. per week. Wages.

There are many braid factories in these enterprising towns of Barmen and Elberfeld, and when braids are in fashion there is an enormous consumption of worsted, mohair, and alpaca yarns, nearly the whole of which are spun in Bradford. This important industry is almost entirely monopolised by these twin towns. We did not find that any scientific skill or knowledge is required by either the masters, foremen, or operatives engaged in the trade, or that it has been influenced by any special technical schools. Undoubtedly many of the employers are men of more than ordinary commercial enterprise, for it is said that they cover Europe with connections, and are unrivalled by the braid manufacturers of any country. We did not hear any substantial reason assigned as to why this important, but somewhat fluctuating, industry should have taken such deep root in these towns, while it is said to have languished in England. The yarn is nearly all spun in Bradford, and the import duty and carriage have to be added to its cost on reaching these distant factories. After the The industry a monopoly. Yarns come from England.

Braid factory, Barmen.

processes of manufacture, which do not require any serious outlay of capital, or any highly developed skill unattainable in England, a considerable proportion of the finished braids return to England to be sold either for home use or for transhipment. It might naturally be assumed that the chief reasons for this monopoly are to be found in the lax Factory Acts, the long hours, and the low wages of Barmen and Elberfeld. But these favourable conditions of cheap production apply as much to the spinning as to the weaving of the yarns. For example there are spinners in these towns who employ women and children at such wages as we have quoted, and run their factories 12 hours per day, and more when overtime is profitable, while at the same time the law limits the working hours of similar operatives in Bradford to 56½, yet one of the most important of these spinners stated that "it was impos- "sible," even in Elberfeld, "to make yarns for the prices accepted "by Bradford spinners." So far as we were able to ascertain, it cannot be shown that these towns possess a single natural advantage over England to account for their monopoly of this industry.

Localisation of manufactures.

On the other hand, it is equally remarkable that the yarns which are made and sold in England for braids, should not also be woven in England. We have elsewhere drawn attention, in relation to the fact that the chief product of the woollen yarns spun at Verviers is exported to England, that the chief proportion of the lustre and demi-lustre yarns manufactured in Saxony are spun in Bradford; and we have this third instance brought before us of Bradford furnishing the chief supply of yarns for an important foreign industry. We allude to these anomalies, not so much to give any detailed explanation of their causes, as to point out that manufactures take root in certain localities apart altogether from those conditions of material resources, situation or commercial advantages, which are generally supposed to determine the success or failure of industrial undertakings.

We should add that the braid factory visited by us was a joint stock company, and was said by our conductor not to be paying a dividend.

Worsted Spinning and Manufacturing in Alsace.

Cotton and wool spinning and manufacturing form important industries in Alsace.

The spinning and manufacturing of cotton and wool are among the most flourishing of the industries of Alsace, and hold their own in competition with other parts of Germany, France, and England. Mulhouse forms a centre of a wide district in which the cotton, woollen, and worsted industries are prosperously conducted, and the evidences of success and development are as remarkable in many of the thriving villages situated in the mountain valleys of the Vosges, far away from railway communication, as in the town of Mulhouse itself. The industrial activity displayed in the manufacturing villages of Alsace may be compared with that of the villages of Lancashire and

the West Riding of Yorkshire. The Commissioners were not able to pay special attention to the cotton industries of this district, but visits were paid to some of the more important of the woollen manufactories, and evidence was obtained from some of the leading proprietors. It is of interest to notice that in one of the large manufacturing establishments in the neighbourhood of Mulhouse, which we visited, as in many others that we did not see, nearly the whole of the goods manufactured were being exported to England and to America, and were superseding goods of English manufacture. We ascertained that the raw material was purchased at the London sales, and spun on machinery made in England or in Alsace; that the whole of the looms in the factory were made in Yorkshire, and that their cost was increased by an import duty and other expenses to the extent of from 20 to 30 per cent. We were further informed that the coal supplying motive power to the factory was treble the price of coal in Yorkshire, and yet these goods, produced at this great extra cost, were being largely sold in England.

Increase in imports of worsted fabrics into this country.

There has been much discussion in manufacturing circles in England, during the last few years, upon the great increase in the import of worsted fabrics, and many reasons have been given for the supposed decadence of this branch of English industry. Without entering closely into the whole question, a few facts may here be stated.

Methods of spinning.

In the first place it may be explained that the English method of worsted spinning as practised at Bradford, which is the centre of the English worsted industry, is what is known as the "throstle" or the "cap" process, while the "mule" process is practised in Alsace and on the Continent generally.

Plan adopted at Bradford.

For long-wool fabrics, which have long been a speciality of Bradford, the throstle principle of spinning has been universally adopted. For short-wool and all-wool fabrics, which have not been so extensively made in Bradford, the cap spinning of Bradford produces the same counts from the same wool as the mule spinning of the Continent, but the appearance of the yarn is somewhat different, and for some purposes the Continental yarn finds a preference, and for others the Bradford yarn.

Fashions have recently changed.

During recent years, however, the fashions have been in favour of goods made from soft yarns, while the lustrous yarns from Alpaca and English long-wools have been quite out of favour. The result has been that the long-wool machinery of Bradford has not been fully employed, while the machinery of France and Alsace, and also the short-wool machinery of Bradford, has been in full and profitable operation. The machinery adapted for alpacas and the long lustrous wools, which have long been so profitably manipulated in Bradford, cannot, without important alterations, be utilised for the short and fine wool which has more recently been in general demand; hence there has been depression in Bradford, but activity in Roubaix and

Alsace. English manufacturers, however, spurred on by the absence of demand for their lustrous and mixed goods, have in many instances given greater attention to the fine short wools and the machinery for their production. They have thus gained some successes in a new field, while at the same time they have shown great enterprise in developing new combinations in their own special branches.

English methods of spinning differ from those on the Continent.

Mule spinning has only recently and in but few cases been introduced into the Bradford trade, and we did not hear of a single factory in Alsace in which worsted spinning by the English method is adopted. The preference shown for the goods produced abroad seems to be due to the different methods of production, rather than to greater cheapness, or higher quality.

Factories of Alsace, well arranged.

The factories visited by the Commissioners were admirably arranged, and the machinery was of the most modern character. The wool is almost invariably spun without oil, and the yarn is thus prepared for the most delicate colours in the dyeing. The hours for work are 11 per day, or 66 per week.

Length of mules.

The spinning mules vary in length; at one factory of 38,000 spindles, employing 1,600 workpeople, the mules, on an average, contained about 500 spindles each (in one factory we saw mules 1,000 spindles long), and the spinners and minders were men and boys. The combs and carding engines were usually minded by women and girls. The half-timers, from 12 to 14, attend a school connected with the works, during a certain number of hours per day. In most of the operations the work is paid for according to the weight turned off, and great care is shown in the overlooking of the work done. In the above factory, where it appeared that a large proportion of the yarn was being reeled, it was all carefully overhauled by girls, who "perched" the yarn before large windows in a south light, so that every thread was examined. It was estimated that there were not less than 80 girls so employed.

All yarn carefully "perched."

From the refuse soapsuds, gas is made, which is used for lighting the works.

Spinning machinery made in Alsace.

All the spinning machinery is made in Alsace, excepting certain special machines which had been procured from England for the purpose of being tested against the Alsatian machinery. The manager of the factory expressed a preference for local machinery, not that he considered it cheaper or better in any way than English, but because the "hands" are accustomed to it, and the machine shops being near are readier for duplicates and repairs.

Wages, hours of labour, cost of production.

The wages of the operatives are lower than for mule spinning in England, but there did not seem to be the same activity on the part of the spinners, that one notices in a Lancashire factory. We did not obtain any evidence as to the amount of work done per spindle, or the general cost of production in a day of 11 hours in Mulhouse compared with a day of 9½ hours in England. It was stated to us that the cost of production

in Mulhouse in 11 hours a day is less than in Roubaix in 12 hours, but this result may be influenced by the lower rate of wages paid in Alsace.

Manager highly trained.

The manager who took us over the largest of the works could understand English, and was spoken of as a man of considerable attainments, not only as an engineer, but also as a chemist. He was educated at the École Centrale in Paris.

Technical schools do not appear to influence wool spinning in Alsace.

We could not ascertain that in actual mechanical operations the wool spinning establishments of Alsace have received any direct benefit from the technical schools. It was, however, alleged that the general schools had, during recent years, greatly raised the intelligence of the workpeople, and thus contributed to the superior character of the productions; and it was also stated that in the operations of wool washing, the scouring ingredients are chemically studied with reference to their effect upon the fibre, and also with reference to the subsequent dyeing operations. The great influence of the School of Chemistry upon the calico-printing industry is universally acknowledged, and it is also credited with having materially increased the reputation of the woollen manufacturers of Alsace, by the improvement it has effected in their dyeing.

The Commissioners noted the personal appearance of the workpeople going to and from their meals, and more particularly at 6 p.m., when the factories were closing. The men were dressed mostly in cloth, and wore flat-topped, silk caps. There were comparatively few of the blue blouses so general a few years ago. The women, who were almost invariably short and stout, had no shawls or bonnets, but wore short loose jackets, which came to the waist, and covered cotton print dresses or cotton and wool mixtures. We did not consider that they compared favourably as to physical strength with the work-women of Yorkshire and Lancashire.

Absence of beggars.

There were no unemployed people to be seen in the streets, no beggars, nor any evidences of abject poverty.

No drunkenness in Mulhouse. Cause of drunkenness in Alsace.

As to drunkenness, which we generally observed to be conspicuous by its absence, we saw three or four exhibitions in two of the Alsatian villages, but none in Mulhouse. It was alleged, however, that drunkenness has increased since the German annexation. Before that time wine was the general beverage, and a drunken person was rarely seen. After the war, the French wines were subjected to a high duty and became dearer. Spirits, on the other hand, were reduced in price 50 per cent. The consequence has been that people have been tempted to drink less wine and more spirits. Beer has never been much drunk in Alsace. We give this statement for what it is worth, bearing in mind the natural tendency on the part of some of our informants to look unfavourably on the consequences of a change of nationality.

Silk Industry, Crefeld, Rhenish Prussia.

Visit to Crefeld.

Your Commissioners visited Crefeld on the 2nd of June 1882, accompanied by Mr. Bueck and Mr. Mulvany, and were met at the railway station by the Burgomaster, the President and several members of the council of the Chamber of Commerce, and some of the leading silk manufacturers of the town, nearly all of whom could speak English.

We visited the silk-conditioning house, which it is unnecessary to describe, as in its chief features it resembles the establishment at Lyons. (*See* p. 266.)

Silk dyeing.

To the important department of dyeing, the silk industry of Crefeld owes much of its reputation. We did not, however, find that hitherto any special chemical knowledge was possessed by the workmen or the ordinary foremen. In view, however, of the competition of other countries, and from the fear that they may be surpassed in this branch of their trade, one of the most carefully arranged departments of the new school of textiles has been equipped as a school for silk dyeing.

One of the proprietors of one of the more important dye-works, is a chemist of more than ordinary scientific, and of superior practical, knowledge. Beginning life as a workman, he had acquired by private study a thorough knowledge of technical chemistry, and by his personal attention to details, the works have attained a position of high repute. The machinery and appliances are of the most modern type, although probably not more advanced than those of leading works in England. A total of about 3,000 lbs. weight of silk is dyed per day, representing an enormous number of varieties and colours.

Working dyers not scientifically educated.

We gathered that here, as at Lyons, the splendid dyeing for which both towns have become famous is due, in the first place, to the choice of proper colours and the adoption of sound methods of preparation by the directing chemists at the head, and, in the second, to long practice and care on the part of the working dyer who knows nothing of chemistry, whose attention is confined to that one operation which he can do well. In the ordinary course of trade in a large establishment, it was maintained that no amount of chemical knowledge among the dyers would give better results than these; everything depends upon the efficiency of the men at the head, and, if the working dyers had more theoretical and less practical knowledge, the general results would not be so good as they are. If suddenly these men were all to exchange places, then for a time there would be bad work and general confusion, but, as such changes are not likely to happen, the system is the cheapest and most effective that has yet been devised.

Hours and wages of dyers.

Dyers work 11 hours a day, and are paid fixed wages; from 17*s.* to 18*s.* per week for ordinary workmen, up to 25*s.* per week

for the best. Overtime is general when the works are busy, and is paid at an increased rate.

In one of the large factories we saw some superior looms weaving velvets by power,—two pieces in one loom which were being divided as they were woven. Since our visit these enterprising manufacturers have been able so far to improve their machinery as to weave four and even six pieces in one loom. The looms are all home-made, but some warping rollers from Switzerland were pointed out as of superior construction. Power loom velvet weaving.

At one of the large warehouses of the town, we were shown a magnificent display of silk goods, including velvets, brocades, plushes, satins, ribbons, and neckties, &c. Among the novelties there were ribbon velvets for Alsatian, Swiss, and Spanish peasant costumes, and indeed for costume dresses for all parts of Europe. It is usual to receive large dressed dolls from customers in different countries, attired in costumes exactly copying those worn by the people themselves. A number of these were brought out for our inspection, showing the make and shape of dresses, and how the fancy ribbons and trimmings are worn. The trade of this firm is very like that of Lyons. They have no factory and no power looms, but they employ 2,600 looms in the town and country districts, and the weavers have warp and weft weighed out to them, and the designs and cards for the looms are also supplied by the firm. Most of the fancy weavers are also designers in their way, and have been taught from infancy to weave and to "tune" the loom. In many of the cottages the loom is never idle. Whatever may be the ordinary employment of the several members of a family, all know how to weave, and when those who have been at work in the fields during the day return from their labour, they take a hand in turns while the regular weaver rests. By continuous working, say from 10 to 12 hours, a Crefeld silk weaver earns from 3*s* to 5*s*. a day. Silk warehouse, Crefeld.

The change from hand to power loom weaving is rapidly extending in this district, and there is none of the fierce opposition to the alteration that has been so often experienced at Lyons. Its great economy is manifest. When work is executed at a distance from the warehouse, the weaver necessarily takes a supply of material to last several days. When this applies to hundreds of weavers, the amount of stock in their hands must represent a comparatively large capital. The concentration of labour in a factory enables the manufacturer to exercise more personal supervision over each loom, to work with less dead stock, with less likelihood of loss and waste, and to turn over his capital much more frequently than under the cottage system. Change from hand to power looms.

We were informed that the total silk products of Crefeld reach the annual value of 4,200,000*l*., of which the overwhelming proportion is exported to England and America. It is a fact that the silk manufactures of this town of 83,000 inhabitants greatly exceed in value the total exports of silk goods from the United Kingdom. Value of silk products of Crefeld.

Faith in technical education, Crefeld.

In conversations with the several gentlemen who showed us their schools and factories, we were much impressed by their enthusiasm for technical instruction, and the hearty interest which they manifested in their weaving school. The new school, which we saw in course of erection at the time of our first visit, and which has since been visited by one of our number, is fully described in another part of our report. In regard to it, one of the promoters significantly remarked, "It does not follow that "the establishment of this school will render us independent of "outside sources for designs or new ideas; we do not expect it; "but, to say the least, it will raise the tone and knowledge of "our rising manufacturers and foremen, and very materially "widen the field from which the latter class may be selected, "by spreading technical education broadcast among the in-"dustrious and ambitious artizans."

Knowledge of England.

We were impressed by the familiar acquaintance with England, possessed by these Crefeld manufacturers. As already stated, with one or two exceptions all could speak English fluently. They visit England frequently, mainly because their chief trade is with England. They mostly sell their goods direct to the large houses in London and other cities, and they ascertain from their customers what are the probable wants of the public, and in which directions changes are likely to be required. They see by these means the productions of their rivals, and quickly learn what to imitate or avoid.

English competition feared.

In speaking of the competition of other countries, one of the largest manufacturers declared that, in watching the recent development of the silk industry, the best informed and most enterprising manufacturers were much less afraid of the future competition of France and Switzerland than of England. In power-loom weaving in particular, and in improvements in machinery, one English manufacturer had outstripped all rivals, and at the present time the honour of possessing the largest and probably the most successful silk factory in the world belonged to a Yorkshire manufacturer.

Free trade.

All our entertainers declared themselves to be free-traders. They do not suffer from English competition in Germany, and they buy large quantities of fine cotton yarns, single and two-fold, from England. The increased duty on what they buy increases their costs, and they would like all duties to be abolished.

Textile Manufactures.—Chemnitz, Saxony.

Cotton and woollen mills, Chemnitz.

In the town of Chemnitz and its immediate neighbourhood are eighteen factories of various sizes, for the spinning of cotton and wool. But of far greater extent and importance is the

weaving industry, which is represented by eighty-two establishments. Within thirty years much of the weaving was done by hand; the country people coming to the warehouses in the town for warp and weft, which they carried to their homes in due time returning the finished pieces. Factories with power-looms have superseded the hand-looms, and the volume of trade has increased in a still greater ratio. Just as the general trades are varied, so the weaving industries are remarkable for diversity; and although probably the manufacture of plain goods is still an important branch of industry, there has been a marked development during recent years of fancy weaving. In scarcely any instances do the manufacturers spin their own yarns. They go into the open market for them, buying endless varieties to suit their requirements, and there are merchants and agents representing spinners in every country. In accordance with the fashion of the hour, the fancy manufacturers buy woollen, worsted, silk, cotton, or jute yarns, and the prices of the leading export spinners of Bradford and other towns are daily posted in the Exchange, in the same manner as the lists of stocks and shares.

Advantages of purchasing yarns instead of spinning them.

The arrangement by which manufacturers, instead of spinning their own yarns, buy them in the open market, possesses marked advantages. They are not required to keep varied stocks of wool or other raw material, nor to find an outlet for their yarns; thus they need only consider the weaving of goods actually in fashion. Variety is thereby encouraged, and the overlookers and weavers are trained in weaving various classes of goods from different materials.

English machinery and yarns.

In the factories which we visited, we found a large number of looms from Bradford and Keighley, working side by side with those of Chemnitz. Some were engaged on plain all-wool goods and cashmeres from French and Alsatian yarns; others on plain lustres and other makes from Bradford yarns, and highly figured worsted damasks from Bradford material, both warp and weft. In one of the largest factories nearly all the looms were engaged upon jute damasks, with a sprinkling of wool damasks of complicated patterns. We were informed that the jute trade has only been taken up in Chemnitz within recent years. The fashion for jute curtains and "furnitures" came up a few years ago, and some of the manufacturers who were makers of worsted damasks—receiving the whole of their supply of yarn from Bradford—changed their material from wool to jute, so as to follow the fashion, and were thereby able to keep their looms running, although by ceasing to use worsted yarns, they stopped many spinning frames in Bradford, and contributed to the commercial depression in that town.

The conditions under which we saw the jute-weaving carried on were unpleasant, if not unhealthy. The rooms in one factory were crowded with [illegible] uards reaching to the ceiling;

the passages were narrow, and the fluff and waste from the fibre filled the atmosphere and covered the clothing of the weavers. This was, of course, owing to the nature of the material, which completely overtaxed the provision for ventilation.

Examination of pieces, Chemnitz.

In every establishment the arrangements for "perching" and "burling" the pieces were most elaborate. In a factory of less than 150 looms, we passed through a room entirely filled with tables, on which the woven pieces from the looms were spread for examination and repairs. In complicated patterns it may not be usual for weavers to "pull back" when threads in the warp are broken, or it may be considered more economical to allow a thread to run down rather than stop the loom, but we were somewhat surprised to find about thirty girls looking very carefully over the pieces and repairing the faults that had been allowed to pass the weavers. This elaborate perching is characteristic of all the leading factories on the Continent, and applies not to weaving only, but to spinning. Every fault is vigilantly sought out, and, if possible, removed; yet at the same time it would seem that the faults must be very many to furnish labour in this class of goods for upwards of 30 "restorers" in a factory of 150 looms. The system undoubtedly speaks well for the determination on the part of manufacturers that their goods shall be faultless when they are sent to their customers; but in making a comparison with English operatives we have fair reason for believing that both yarns and pieces are generally in a better condition after leaving the spinner and weaver in England, than in Germany or France. But this superiority in the original workmanship is no excuse for the English, in allowing their commodities to be presented to the world less perfect and attractive than those of their rivals.

Hours and wages.

The operatives, as in other districts, work 12 hours a day, and payment is made by piece. We ascertained that generally the earnings of weavers during a day of 12 hours, including meals, are not more than those of Bradford in 9½ hours.

Influence of weaving school.

In conversations with employers and foremen, the importance of the weaving school of Chemnitz was everywhere acknowledged. One of the employers stated that its influence upon the manufacturing industries of Saxony could not be too highly estimated. We were told that there was not a fancy manufacturer in the town whose son, assistant, or overseer, had not attended some of the classes.

Visit to a warehouse.

Training of manufacturer.

We paid an interesting visit to the warehouse and show rooms of one of the largest manufacturers in Saxony. The head of the firm, who takes the practical management of the business, had studied designing and weaving in the weaving school at Lyons, and conspicuous in his office are some remarkable examples of silk weaving, in which the designing, setting of the cards in the loom, and the weaving of the fabric, were done by his own hands. He also studied chemistry at a Polytechnic School, and

in his youth visited and worked at some of the chief dyeworks and factories in England.

Drawings of English mills.

On a former visit he showed to one of the Commissioners a large book, containing plans of some of the most modern and complete mills and dyehouses in Yorkshire, with the arrangements of the shafting, machinery, &c. These details had been transcribed by him from a small note book, in which the particulars were entered at the time of his visits. He declared that his knowledge of drawing, and general mastery of detail, were due to the technical education which he had received in his youth.

Variety of the goods manufactured.

The products of the firm were very varied, consisting of dress goods and mantle cloths of great variety; also all kinds of fancy goods for furnitures, hangings, table cloths, &c., in wool, cotton, silk, jute, and in combinations of these materials. An enormous collection of patterns was shown to us, and the markets were freely mentioned where most of the goods are sold. Nearly the whole of the products of the factories are exported to England and America, and, in passing through one of the pattern rooms, we saw a large portmanteau which was being packed with a great variety of patterns, containing hundreds of separate designs, which one of the travellers of the firm was preparing to take with him to the London and Manchester markets.

Yarn comes from England.

We were informed that the firm buy worsted yarns and warps from Bradford, and cotton yarns from Manchester; they pay carriage and an import duty on these yarns entering Germany; weave them into fancy goods, finish, make them up, and pay carriage back to London, Bradford, and Manchester, selling them in the very centres of competition. A very large proportion of the entire products of the establishment, even though the yarn comes from Bradford, are sold in England.

Finished goods are extensively sold in England.

It was alleged, as one reason why these goods are sold so extensively in England, that similar goods are not made in England. Their manufacture necessitates superior skill in designing and weaving, and a varied and technical knowledge of dyeing; these requirements, through the influence of technical schools, have been carefully attended to and mastered in Chemnitz, but have not received the same attention in competing towns in England. He feared that England was awakening, and, if so, it would be so much the worse for him.

Designs.

The designing in this establishment is executed by three head designers, who originate, and from six to eight assistants, who enlarge the designs on paper prepared for the purpose, and arrange them for the cards, which are then passed forward to the loom.

Designers were trained at Dresden.

We saw two head designers at work, men apparently under twenty-five, and found, on inquiry, that both had been trained at the Industrial Art School at Dresden. In reply to a question as

to the influence of Paris on the trade designs, we were informed that it did not suit the purpose of this firm either to send to Paris for designs or employ designers who had exhausted their originality at other places. Parisian designers worked in a particular groove, and Parisian designs were supplied to their competitors both in Germany, France, and England, with this result, that the same *style* pervaded the whole trade. What they wanted and sought after was originality, combined with good taste, and these qualities could best be found in talented young men, full of inspiration and ambition, fresh from the best schools and teachers. These young men from Dresden were doing excellent work, and as they had a style of their own, or at least a style that was not an imitation of Parisian methods, the firm were able to offer novelties which attracted customers, and the business prospered in consequence. We ascertained that the knowledge of these designers did not go beyond the power of drawing and painting the designs themselves; the technical part of the work had to be done by the six or eight assistants who had attended the Chemnitz Weaving School. In this instance the Industrial Art School at Dresden had supplied the artist; the Chemnitz Weaving School the more technical designer, who *applied* the work of the artist to the actual capabilities of the loom. Neither could do the work of the other. Our conductor was of opinion that, as far as possible, the same training should be gone through by both. The artist should be taught to transfer his picture to the loom, and the technical designer to produce a design for himself. It ought to be the main purpose of the weaving school, in carrying out its highest functions, to bring the artist to the loom and the weaver to the studio.

Designers not acquainted with mise en carte.

Bradford yarn formerly used for fancy goods for the East.

On a previous visit to Chemnitz by one of the Commissioners, he found one of the largest factories engaged exclusively in the manufacture of goods from Bradford yarns. A comparatively new branch of trade had been started, requiring very complicated designs of foliage and birds in varied colours, a work of great difficulty both for designer, dyer, overlooker, and weaver. The question was asked, "Were these goods sent to England?" The reply was, "No; they were being sent to the East, and were "there taking the place of goods, less elaborate and pictorial, "which up to that time had been exclusively supplied by "England." The manufacturer further remarked that it would have been impossible to have made these goods so as to surpass English goods, but for the facilities afforded by the Weaving School, in teaching designing and jacquard weaving to a member of the firm, and to the overlooker entrusted with the practical management of the looms.

Bradford yarn now less extensively employed.

In describing the important industry of the spinning of woollen yarns in Verviers, Belgium (*see* p. 358), we comment upon the large export of that yarn to Glasgow. A few years ago the manufacturers of worsted goods in Saxony were almost equally

dependent for their yarns upon Bradford. It was stated that, at the time of our visit, the import of worsted yarns from Bradford was very much smaller than a few years ago; but it was not ascertained that this lessened consumption of Bradford yarns was due to the competition of Saxon or other spinners, as has often been alleged, but rather to the fact that fashion has favoured a class of goods for which Bradford yarns are not suitable. It is not necessary to describe these changes in detail, but a few facts by a Chemnitz manufacturer may not be uninteresting. He stated that when the depression fell upon what were known as "Bradford goods," which were extensively manufactured in Saxony as well as in Bradford, and for the same markets, he and others, finding that these goods were no longer wanted, turned their attention to other goods from other yarns, and by this means were able to run their machinery and keep their work-people employed. Many of these new goods were of a fancy character, which, within the range of the capacity of their looms, they were able to make in consequence of the skill in design of the masters and managers, and the knowledge of fancy weaving possessed by the operatives. It was represented by the manufacturer that his rivals in Bradford had long ago fixed their sails to the prevailing winds of fashion, and, while the fashion was with them, they distanced all competitors; but when the wind changed they were altogether unprepared for altered circumstances. The Chemnitz manufacturers, with greater range and adaptability, were better able to alter their sails to the changing fashion, and thus were fairly employed while Bradford was suffering from exceptional depression.

Depression in the woollen trade, how in Chemnitz.

The Chemnitz Weaving School is to be credited with much of the variety and excellence of the textile manufactures of the district, and with the greater power of adaptation from one class of goods to another, than is found in similar manufacturing towns in England, where no such schools exist.

Importance of the Chemnitz Weaving School.

In visiting textile factories in Chemnitz, and coming in contact with the manufacturers of the town and neighbourhood, the Commissioners were impressed with the intimate connection existing between this district and Bradford. Bradford merchants are represented by agents, and the names of Bradford spinners are known as familiarly as in their own town. In the spinning of lustre, demi-lustre, and damask yarns, the manufacturers admitted that Bradford yarns were unrivalled, and that there had been no period of prosperity in Chemnitz equal to that in which, a few years before, the Bradford yarns had monopolised almost every loom.

Intimate connection with Bradford.

The employers of Chemnitz spoke with pride of the growth and rapid prosperity of their town. The population increased from 54,827 in 1864 to 89,224 in 1879, and no less a sum than 240,000*l.* has been spent upon schools, of which 95,000*l.* has been contributed to the higher schools by the State. The zeal

Growth of town and school expenditure.

of the inhabitants for technical education may be estimated when it is known that the technical schools of this town have cost 88,000*l.*

Variety of the industries a safeguard against depression in trade.

We have previously mentioned the variety of industries, which give employment to all classes of the inhabitants of Chemnitz, and act as a natural protection against those periods of depression which visit with exceptional severity towns which rely largely upon one branch of industry. In this respect the town of Bradford (which for substantial development and material growth puts into the shade any town on the Continent) has recently appeared at a disadvantage. The commercial depression in Bradford is said to be passing away, at least for the present, and will probably not return in the same form. Its leading industry, which gave employment to the bulk of its population, became depressed through a combination of causes,—change of fashion, over-production, and foreign tariffs. The depression was more general and more severe than would have been the case in such a town as Chemnitz. The important influence in every direction of the technical and scientific schools of Chemnitz, in building up and sustaining the efficiency of the varied industries of the town being admitted, it would be reasonable to suppose that, had the buildings and organization for technical instruction which are now provided in Bradford, been in operation during the past few years, the educated talent thus brought into the trade would have helped to produce a greater variety of goods to meet changing demands.

Value of the technical schools.

Designing for Textile Industries and Calico-Printing.

Designing for textiles and printed fabrics.

The subject of designing for calico printing, as well as for silk and other textile fabrics, has naturally engaged the attention of your Commissioners; and we have had an opportunity of obtaining the opinions of those practically acquainted with the subject both at home and abroad. We learnt from these gentlemen that, whilst patterns and designs suitable for foreign markets such as India, China, the Levant, and Africa, are as a rule drawn by English designers at home, the English calico-printers look to Paris as the source whence must be procured the most delicate and tasteful designs, suitable for what is termed "City taste," that is, for our home markets and for other highly civilized communities, where harmonious colouring and artistic design are essential.

Paris designers.

The designers for textiles and printed fabrics in Paris form a special profession, having their trade organizations, agencies, their studios, and their system of apprenticeship; by arrangement with the English manufacturers patterns are sent to them for inspection or choice. Sometimes, an English firm has even established an "atélier" in Paris, so convinced have our calico-

printers hitherto been that for the highest class of their goods Parisian taste and skill are essential conditions.

Earnings of French designers.

"A good designer in Paris may earn from 250*l.* to 300*l.* a "year, and the most distinguished, even considerably more than "this, but, as in other trades, it is often found hard to earn a "living.

Training of apprentices.

"Apprentices are taken by the Paris designers, beginning at "about 5*s.* a week; they are required to practise model drawing "and are encouraged to attend the evening drawing schools, care "being taken to insist upon their working from natural ob- "jects such as flowers and foliage. Some apprentices have "already been employed in calico print-works, and these are "specially useful, because they comprehend the purpose of the "design; this knowledge is, indeed, essential to a good trade "designer, he must know not only how to make a good and "effective design, but one of which the cost of execution is as "small and the mechanical means as simple as possible.

Reasons for the success of Paris designers.

"The great secret of the supremacy of the Parisian designers "may be said to be "environment." Their success depends on "their being surrounded by the arbiters of fashion. Good taste "never changes, but fashion changes constantly, and Paris is the "centre of such change. In practice, the designs in the less "expensive follow those in the more expensive article; thus the "designs of the calico-printer are frequently adaptations of "figures and patterns employed by the silk weaver. Paris being "the centre to which all the newest and most fashionable goods "gravitate, the designer anxious to obtain ideas has, as we have "been told, simply to take a stroll on the Boulevards and "observe the novelties of various kinds in the different well "arranged shop windows, in order that his ingenuity may "develope what he has seen into a striking and marketable "novelty.

Designers are not mere adapters.

"The true designer is, however, not one of these mere adapters "of the ideas of others, but a man of original power who creates "the design, commencing with work suitable to the rich and "costly fabrics of Lyons. These are then, as we have said, "carefully studied and rapidly adapted to the needs of the "calico-printer by the ordinary designer of Paris. But, whilst "the Frenchman is quicker and more supple in following "the rapid changes of fashion, the English designer is quite as "well or indeed better, adapted to produce patterns to suit "Eastern taste, as he grasps more thoroughly the peculiar cha- "racteristics of Oriental feeling than the Frenchman, who is "often desirous of improving on the old ideas, and introduces "changes and forms which often destroy the value of the design "in Eastern eyes."

English designers can produce patterns suited for the East.

The foregoing paragraphs express the opinion of an English calico-printer, whose firm print for the Eastern market from

English designs. Other English printers, it must be noticed, rely on Parisian designers both for their "city" and Eastern goods.

Comparison between the value of French and English designers' work.

In discussing the relative value of the so-called French and of the English design and work in the calico-printing trade, it is important to distinguish between the printers of Alsace (now German) and those of Rouen and the north of France. In harmony of colour and delicacy of finish we are probably still surpassed by the Alsatians, but certainly not by the printers in Normandy; indeed it would appear that these latter have not fully availed themselves of the opportunity to improve their production since the annexation of Alsace and Lorraine, whilst the printers of the annexed provinces, with a 20 per cent. duty against them, still continue to hold the command of the "fine or millinery" trade of France. It is a common, but false, idea to suppose that the Alsace printers "fix their colours" better than the English; indeed the reverse may more truly be said to be the case, for in Alsace certainly beauty of appearance has been studied before everything else, because the wealthy classes, who have bought the Mulhouse goods, seldom wash their print dresses, whilst in the English home market a printer who delivered fugitive colours would very soon have the goods on his hands. Of course, as is well known, certain very cheap articles, termed "steam prints," are produced in England, but these goods make no pretensions to fastness of colour, and in no way deceive the purchaser. We need scarcely add that England still remains undoubtedly master of the calico-printing industry in neutral markets, nor refer to the fact that, owing to foreign tariffs, the richest and most refined markets, such as those of the United States, France, Spain, Germany, Austria, and Russia, are practically closed to us, and that therefore, with the exception of our own home trade market, the demand for the highest class prints is, after all, small compared with the immense extent of the trade in Eastern and other foreign markets. Hence the English printer who seeks to compete only with the productions of Alsace, would have to depend rather on the fickle element of fashion than on the demand in the neutral markets of the world.

Impression that foreign calico-printers fix their colours better than English manufacturers is erroneous.

Many foreign markets are closed to English calico-printers.

Technical Education amongst the Alsace Printers.

Technical education of the Alsatian calico-printers.

From our own observation, as well as from the evidence given before us by Mr. Haeffely, there is no doubt that a greater amount of scientific and especially of chemical knowledge exists in foreign calico-print works than in those of this country (see page 1 of evidence). The Alsace managers are invariably trained chemists, and a special profession, that of colourist chemist, exists on the Continent, which has not yet obtained a firm footing in our

own country. The necessity for supplanting the rule of thumb processes and pretended secrets of the old-fashioned colour-mixer, by scientific knowledge of the materials with which they deal and of the reactions which they employ, is now becoming felt by all the better class of English calico-printers, and in many of these establishments at the present time technically trained and competent young men are found. Equal opportunities for the study of this branch of applied science exist at the present time in England to those found on the Continent, and there is no reason why the colourist chemist trained in England should not become as efficient as the one educated in Alsace, so soon as the demand for, and the appreciation of, his services is as great with us as it is abroad.

Want of more scientific knowledge is felt in this country by calico-printers.

Engineering and Machine-making Works, Alsace.

The making of machinery for the spinning and weaving of cotton, wool, and silk, engineering, &c., is one of the largest and most important of the industries of Alsace. Before the annexation, the great bulk of the textile machinery of France was made in Mulhouse, Guebwiller, and other towns of Alsace, and, even in spite of protective duties, much of the cotton and wool machinery now employed in France is imported from Alsace, no French makers having yet arisen to supersede those of their lost province. The chief rival of Alsace in France is England, which has reaped considerable advantage by being placed on the same footing with Alsace, in the supply of textile machinery to French manufacturers.

Engineering works in Alsace.

The machine and engineering shops visited by the Commissioners resemble in many respects those of England. In the shops where spinning and weaving machinery is made, machine tools (many of English make) are in general use, while the same subdivision of labour and the same system of piecework prevail as in the large shops of Lancashire and Yorkshire. Apprentices are taken without indentures, and employers are under no obligation to teach them more of the trade than it is to their own advantage for the apprentice to learn. The consequence is, that, as in England, a skilled mechanic may be described as a fitter, or a turner, but not generally as both. Apprentices are early put to piecework, and, as their wages depend upon the quantity of work they can get through, they are not anxious to change from one class of employment to another, since by so doing their weekly earnings would be lessened. It suits the purpose of mechanics to work at what brings the highest wages, and of employers to keep the men at what they can do best, and thus, as a natural consequence, the bulk of the men learn only to do one thing, but as they do that one thing well and quickly, the aggregate result is a good and [illegible]e.

Shops visited resemble those of England.

Special system of apprenticeship.

In one of the large engineering works which we visited, the method of training apprentices was somewhat different from that described above, because more varied work was required of them. More than ten per cent. of the employés in this shop were apprentices, who came for five years, and obtained a general knowledge of the use of several tools and operations; many of them spent a year in the drawing office. This system of training is necessary, because of the great variety of engines and tools which they make, which are for export to other countries; they, therefore, require men not simply to set them up, but to start them, and to teach others how to use them.

Care taken in the selection of apprentices.

The director of the works informed us that they take great pains to select educated boys as apprentices. Most of them have gone through the Professional School of Mulhouse, and have there learned the use of tools, obtaining in many instances an excellent preliminary training in theoretical engineering. They give a decided preference to boys from this school. The foreman who conducted us over the works, himself a student from the Polytechnic at Zurich, confirmed the statement.

Milling tools largely used.

A noticeable feature of these works was the very extensive use of milling tools, which ensure clean cutting, and a true surface. It was represented to us that no shop in any country is more advanced in this style of work. There was no minute subdivision of labour, as was shown by the great variety of work in hand; working drawings of parts of machines lay on nearly every bench.

Application of electricity to lighting and motor purposes.

The shop was lighted by incandescent electric lamps, distributed to each bench as numerously and as conveniently as gas-lights are with us. It was apparent to the Commissioners that electricity was used with more knowledge and effect than is common in England. We noticed a novel application of electricity to mechanical work. In the yard was a cumbrous casting, like the bedplate of a huge planing machine, in which some large holes had to be bored. It would have been very difficult to convey it into the crowded shop, and the boring was therefore done by electricity. Two small wires, from a dynamo-machine inside the works, fed a motor in the yard, on which were fixed a pulley and belt, which drove a small shaft fitted on firm iron stands; a belt on a counter shaft drove the boring machine, which seemed to be doing its work with the greatest facility and ease. The appliances were superintended by an ordinary workman. It was explained to us that many of the workmen had scientifically studied the applications of this new force, and that all the apprentices from the Professional School had studied Electricity as one of the principal branches of their education.

Engineering and Machine Works.—Prussia.

Your Commissioners visited several important engineering and machine-making establishments in various parts of Germany, and were shown over them with the greatest courtesy. We prefer not to describe any of these establishments in detail, nor to give the names of eminent manufacturers and others from whom information was obtained. When we came in contact with English foremen and workmen, and these cases were very exceptional, or with German workmen and foremen who had been employed in England, we elicited opinions upon educational and industrial questions, and received very valuable and practical information from these sources. Visits to engineering and machine works in Germany.

In Berlin we visited the engineering works of Messrs. Borsig, where 1,400 men are employed, and were shown with the greatest liberality over every part of the workshops. Locomotive works in Berlin.

The men work 10 hours a day, and as in other similar shops in Germany, they are nearly all paid by piece. We ascertained that overtime is calculated at the same rate as regular time. At the date of our visit, such was the pressure of work, that the men in the engine department were working till 8 p.m. Mechanics, fitters, turners, &c., earn by piece from 21*s.* to 30*s.* per week; boiler-makers about 21*s.*; smiths, &c., about 26*s.* by piece. Hours. Wages.

The firm had contracted to make 95 engines during the year. They were turning out two complete locomotives per week, and were competing with England in many European markets. Contracts for 95 engines.

We found that the inflated demand for locomotives which followed the war of 1870, and which caused so much abnormal extension in England, had wrought similar mischief in these and other works in Germany. Here they had enlarged their premises so as to be able to increase their production by from one to three engines per week, but when they were ready for carrying on this increased business the demand fell off, and it seemed for a long time as if they would never be able to employ even half their works again. At least a dozen firms in Germany had enlarged their works in this way, and had since been competing against each other, reducing profits, and causing a hard time for all. Evil effects of inflated demand for productions after war of 1870 severely felt.

At these works there is no definite rule as to the taking of apprentices, and no regulation as to the courses of work which they are required to go through. Boys are not admitted under 14, and apprenticeship lasts until the military service begins. Before service the apprentice is looked upon as a boy; when he returns from training, he has become a man. Apprentices.

Military service takes all young men who do not possess exemption certificates (in which case they serve as volunteers Military service.

for one year) from 20 to 23, and for eight weeks every two years for some years after, and they organise their shops accordingly. Contrary to the opinion strongly expressed elsewhere, one of the foremen did not consider that the three years' absence on military service very materially threw back the mechanic or diminished his skill as a workman.

Military service not objected to by the Prussians.

"Compulsory military service is not disliked in Prussia as it is "in South Germany, where it has not been so long in operation. "Fathers have gone through it, and knowing what it has done "for the independence and unity of their country, they have "taught their sons to accept it as a patriotic duty. The young "man coming back to his work at 23, is able very rapidly to pick "up what he has lost, and from that time is a better man all "round than a man of the same age who has not gone through "the service. The military service teaches order, regularity, "obedience, and the power of working effectively with others, "which in some departments of the works was a distinct advan-"tage. It also teaches the men cleanliness, establishes their "health, and improves their physique and general manners."

Draughtsmen in Berlin.

Fourteen draughtsmen are employed in the works, all of whom have had a scientific education, and most, some experience in the workshop besides.

Training of head draughtsmen.

On inquiring as to the education and training of the head draughtsman, he informed us that, after a fair scholastic education, and a year's experience of practical work in an engineering shop, he entered the Polytechnic at Zurich, and went through the engineering course. Thence he travelled to England and took a situation as engineer and draughtsman at a large engine works in Manchester. He remained here two or three years, acquiring all the information he could obtain relating to the science and practice of engineering, and then came to Berlin, where he readily received an engagement at these important works. This gentleman was of opinion that the plan which he had followed had been of advantage to him. He did not believe that a young engineer could obtain the necessary education entirely in a school. The Polytechnic School course, although very thorough in its way, would be most useful to a student acquainted with practical work. He would recommend a good general education, to be followed by a year in a workshop, and afterwards by a Polytechnic school training.

Training for foremen.

For foremen the only true education was that of the shop. The good foremen with whom he had been acquainted, not only in Germany but also in England, had almost invariably risen from the ranks. Of necessity they were men of more than ordinary intelligence and force of character. Some had received very little education, but by attending night schools, or by private study, they had usually improved themselves in the theory bearing on their daily work.

As to capacity for work, it was the opinion of this gentleman that the Germans do not get through so much work as Englishmen. He noticed this particularly on coming from the Manchester works to those of Berlin. He was unable to give any definite reason for this superiority of the Englishman, but undoubtedly there is not in the German workman the same "go," persistence and "staying power" as is to be observed in the Englishman. He thought it was owing to a combination of race, climate, and the more competitive spirit of Englishmen. He wished it to be understood, however, that, in his observations in England, he had seen quite as much difference between one part of the country and another as between England and Germany. For instance, he was of opinion that there was a surprising difference between the spirit and energy of the mechanics of Manchester as compared with those in other industrial counties. The Lancashire men, he affirmed, work harder, and better, and earn more, even than Yorkshiremen. Capacity for work.

He looked upon German workmen as generally more docile, intelligent, and trustworthy than the English. They are temperate; time breaking through drink is almost unknown; in these works it would not be tolerated for a moment, and all the men know it. There is nothing of the irregularity which he had often observed, even among really good men in England. Berlin was once a drunken city, but the workmen had abandoned this vice. He attributed the improvement to the influence of education. A drunkard was avoided by society as a man wanting in common decency and self-respect. Comparison between German and English workmen.

In making the tour of the works, we were of opinion that the shop arrangements were not inferior to the first class locomotive engine works of England. The engineering tools were of the best description, and were nearly all by English makers. The work was being well finished, and was quite up to the English standard; but there was nothing, either as to appliances, arrangements, or results, which would not be at least equalled, as to quality, in an English locomotive shop. Workshop arrangements.

Our conductor complained that in many important respects they were severely handicapped in competing with England, which is always the rival whose cheapness and excellence they have to fear in every market. Raw material is much more costly than in England, as a large proportion of their iron comes from England; their coal is mainly from Silesia. Competition with England.

The arrangements for promoting the comfort of the workmen during meal hours were much more complete than is usually the case in England. We were shown a handsome dining room, about 150 feet long by 50 feet wide, supplied with numerous tables and chairs. At one end we noticed a platform and a small orchestra, with a number of busts, and a library of books, for the use of the men; at the other the buffet of a well ordered restaurant, where the men could buy food and drink, supplied Dining hall.

at cost price on the co-operative principle. We happened to visit this room when the works stopped for tea (as we should call it) at 4.30. Some of the men took tea with bread and butter, or bread and sausage; others took coffee with bread, butter, salad and cheese. Sausages, sandwiches, and eggs were purchased by many. Upon the whole the food appeared quite as good as would be consumed by a similar class of men in England. Possibly the substantial provision may be accounted for by the fact that the engineers, instead of leaving work at 6, were continuing to work overtime until 8.

Wardrobes and bath.

Another arrangement was noted, which is not often found in workshops in England, and which suggested a greater regard for cleanliness than we usually find in our own country. In the shops each man had a cupboard for his tools and coat, and most of the men took off their cloth coats and waistcoats, and provided themselves with blouses or "check" coats, not unlike those of French workmen. Some put on cotton trousers over their cloth ones. Attached to the works we were shown a swimming bath, in which, in the summer time, the men bathe and wash after their work is done, and before going to their homes. The temperature of the bath can be regulated as desired. About 200 can bathe at one time.

Works of Messrs. Siemens and Halske, Electrical Engineers, Berlin.

Engineering works of Messrs. Siemens & Halske.

At these works from 800 to 900 men are employed, and the firm have other works employing 1,600 men, thus making a total of 2,400.

Electrical machinery of all kinds was being made, and some very remarkable rotary steam-engines for driving the former.

Hours.

Managers have received theoretical training.

The men work 10 hours a day, and nearly all the work is done by piece. Most of the heads of departments have received a theoretical training in schools or classes outside the shop, and the high and deserved reputation of the firm, their great success as electrical engineers, and the liberal wages paid to their workmen (probably the highest that were being paid in any establishment that we visited), all testify to the technical efficiency of at least the superior workmen and foremen, in an industry which necessarily requires high scientific knowledge.

We were conducted over the works by Dr. Werner Siemens, brother and partner of the late Sir William Siemens.

Mechanical appliances very complete.

There is in the works, which in mechanical arrangements and appliances are remarkably complete, a large physical laboratory, where important experiments and tests of the greatest delicacy are carried on. Dr. Fröhlich, a distinguished physicist, who is associated with Dr. Siemens in business, is at the head of

this department. The manager of the works was educated at the University.

Dr. Werner Siemens on education.

In the course of an interesting conversation, Dr. Siemens favoured the Commissioners with his opinions upon education as it relates to young men intended for mechanical pursuits. His own education at school was neither technical nor scientific. He joined the Prussian army and became an officer, but as a military man he worked at science for amusement, with great energy and enthusiasm, as also did his brother Sir William Siemens.

Polytechnic schools.

He was of opinion that in Germany there are more Polytechnic Schools than are necessary. Their number was due to the educational rivalry of the several German states, each of which had aimed at achieving technical superiority over the rest. The motive was excellent, but the result had been costly; yet, considering that the standard of education throughout Germany had thereby been raised, the people felt that their sacrifices had been more than justified. The number of Polytechnic Schools might wisely be reduced, and the money thus saved might be devoted to the establishment of intermediate schools, which are much needed.

Education of workmen and foremen.

As to the education of workmen, everything depended upon the means and natural abilities of the student. He would give, first, a sound elementary education up to 14. At that age it was natural that the workman's son should be required to earn wages and learn a trade, but he ought to attend a night school. After two or three years he should enter, if he could dispense with wages, a foremen's school (like that at Chemnitz), from which, by showing remarkable ability, he would be able to pass to the highest technical schools. If a young man were compelled to work for wages in order to maintain himself, the above course would be impossible. The night school, however, was still open to him, and the highest possibilities were accessible to perseverance and ability.

Promising youths divide their time between the school and the workshop.

In his own works he selected young men of promise, and paid their expenses at these schools, in some cases dividing the year between school and work, so as to enable the students to keep up the connection between the school and the shop. The great problem with him had been to find and train the most promising youths. Although it too often happened that he lost the services of the men after they had been improved, yet in the main the advantages compensated him for the sacrifices. Dr. Siemens said that workmen in other trades very commonly save up their money in order to have a course of schooling, and attend classes in the slack times of winter. Many employers assist their young men in this endeavour to improve themselves, and consider that the gain in increased efficiency is worth the outlay. Dr. Siemens considers it well worth the while of the State to seek out talent wherever it can be found, and to develope it for the benefit of the State as well as of the individual. The foundation of bursaries

for this purpose, uniting the shops and the schools, would be very useful, for it often happens that a young man's talent is only brought out by the practical application of scientific principles at the bench or forge.

Education of employers.

For the sons of employers, and for really clever boys of any class who could afford the time, he considered that the old classical education, as a grand and broad foundation, was best after all as the foundation of subsequent training. But for ordinary boys, it was a pity to waste time on dead languages which they seldom mastered. There was no direct good in Latin and Greek, but there was always direct good in chemistry.

Engineering and Mechanical Industries in Bavaria.

Visits to engineering works in Bavaria.

The Commissioners visited typical works of importance in Bavaria, and also inspected the various industrial departments of the Exhibition then being held at Nuremberg, and were able to note the high degree of excellence attained by several of the engineering establishments. The work in the shops we visited appeared to be fully equal in style and quality to the good work of France, Switzerland, or Belgium, and perhaps not inferior to that of England. One of the firms represented at the Nuremberg Exhibition, exhibited its 1,000th locomotive engine. In various manufacturing districts of the continent, we saw in some of the newest factories, stationary steam engines from Bavaria, which seemed to be perfect in workmanship and in the steadiness with which they developed enormous power. At some very extensive railway carriage and waggon works we were shown elaborate machines and appliances for the saving of labour, and were informed that at these works alone (where upwards of 50 draughtsmen are employed), the construction of complete carriages and waggons is equal to one per hour during each working day of 10 hours, and that in time of pressure the output has been not less than 15 per day. Nearly the whole of these carriages and waggons are exported to other countries, to Russia, Italy, and Spain,* which they enter on precisely the same terms with regard to tariff duties as those of England.

Hours and wages.

The ordinary working hours in the machine shops of Bavaria, as in Prussia and Saxony, are 10 per day, and most of the men work by piece. Irregular work is paid by day, but all the employers with whom we conversed, and the majority of workmen also, were of opinion that the system of piecework was fairest both for employers and employed.

* In Spain there are differential duties in favour of Germany, as against this country, on some manufactures (including iron and steel). By the Convention recently signed by the two countries these will be abrogated, if it is confirmed by the respective legislatures.

At one establishment we were informed that labourers earned about 2*s.* 6*d.* per day, and skilled men from 3*s.* to 4*s.* per day. The proportion of mechanics earning 4*s.* per day is not large.

The arrangement for holding a week's wages in hand seems to be general.

Evidence by English manager.

In making the tour of one of the large engineering establishments in Bavaria, we were accompanied by an English manager of great intelligence and experience, who expressed very definite opinions on several important matters relating to this inquiry. He had served an apprenticeship under one of the most eminent engineering firms in England, and came to Germany as a young man, over 30 years ago, to take a good post at high wages. He and other Englishmen had contributed largely to the foundation and extension of engineering and machine shops in Germany, and he has watched with great interest the progress of Germany as a manufacturing nation. He had made frequent visits to England for the purpose of collecting information, and had taken great pains to form correct conclusions as to the best means of keeping pace with English and other competition. Germany 30 years ago, as compared with England, was simply "nowhere," but, placing English and German workshops side by side now, we should find that the progress in the latter had been positively marvellous. During all these years the Germans had been following the English step by step, importing their machinery and tools, engaging, when they could, the best men from the best shops, copying their methods of work, and the organization of their industries; but, besides this, they had devoted special attention to a matter which England had almost ignored, the scientific or technical instruction of their own people. And what has been the result of all this? They have reached a point at which they have but little to learn from the English. He called our attention to a fact, which had not escaped our observation before, that, now-a-days, there are scarcely any Englishmen to be found at the head of German workshops. It no longer pays to import them. In earlier days the Englishman was completely master of the situation. Practical knowledge counted for everything, and this was the Englishman's possession. In theory he was deficient. During recent years, there has been less and less demand for English foremen on the continent, where practical knowledge has increased, and more and more demand for continental men of science in England. Our guide was of opinion that, were industrial conditions as favourable for Germany as for England, we should require to put forth increased energies in order to maintain our supremacy; but, he also stated that a military system like that of Germany must leave our rivals at a permanent disadvantage; and, after all, no amount of teaching in Polytechnic Schools would wrest from England the mechanical genius which has, in all ages, distinguished her sons.

Germans have been imitating English manufacturers.

English were formerly without rivals.

Engineer apprentices, Bavaria.

On the question of the training of apprentices, the English manager, Mr. A., stated that as a rule, boys are not admitted to engineering shops under 15, and are not bound as apprentices. It is considered a point of honour that the boy should be retained till he is required to join the military service at 20, and it is very seldom that an apprentice is dismissed from his employment or leaves it without permission. The work in large shops is not so completely organised as in England, and although they cultivate "division of labour," there are some departments in which this division cannot well be carried out, owing to difficulties unknown in England. Some boys are put to particular jobs and never leave them, but others are removed from one class of work to another, not that he may learn a variety of things and thus become a more valuable man, but because it cannot be helped. Changes of this character are not popular, but where a certain number of men leave every year to join the army, there must necessarily be a "shuffling" of places among those who remain, and this is one of the evils of the military system.

Young men do not become really useful until after they are 20.

Mr. A.'s experience shows that up to 20, a youth learns but little that can be turned to much account either for himself or his employer. If he be careless, the foreman or employer is apt to say, "I shall get rid of him at 20," and does not take serious trouble to make him better. If the youth has ambition, and the employer sees in him signs of promise, he is still indifferent about putting him forward, knowing that at 20 he will lose him. You cannot keep a place open for the possible return of a promising young man, after three years' absence, and should you do so, you are by no means certain that you will have the same material to deal with, that you had before dreams of military glory had fired his imagination. How different, said Mr. A., are the feeling and sentiment in an English shop; the apprentice seeing his future before him, undistracted by ideas of anything beyond the improvement of his own skill and mechanical knowledge, or advancement in the shop in which he began, and possibly hopes to end his career. These are matters which are not understood in a German workshop, because they have never been experienced, but they have a very important bearing upon the training of a mechanic.

Effects of military service.

When a soldier comes back to the shop at 23, he may be strong, smart, and disciplined, but he has a very indifferent notion of his work, and he forgets day after day what is told him. Yet he has arrived at man's estate, and naturally wants a man's pay, although he can only do a boy's work. It is only by comparison with a country like England that this great drawback is appreciated. Industrially, and speaking as a manager, responsible for the efficiency of the work done in the shop, Mr. A. affirmed that the military system is the curse of Germany. As a rule the mechanics at 25, who expect good wages, and ought to be at their best, have only half learned their trade, and

how can such men be expected to compare in practical skill with English mechanics who have worked at the bench continuously, without any break whatever, from about the age of 14? There is this consolation, however, for most of the men, that they do not marry so early as in England, and if for a time their wages are lower, their expenditure is lower also. The German military system does not by any means tend to the encouragement of extravagance; men are taught to cut their coat according to their cloth, and to make a little go a long way.

No trades' unions.

There are no trades' unions among the workmen in Mr. A.'s town, and in his time there has been no strike against hours or wages, yet the former have lessened and the latter have increased. Undoubtedly German workmen are more obedient to their superiors, and generally more long-suffering, than Englishmen. Insubordination is not in the spirit of the German.

Comparison of English and German workmen continued.

Mr. A. is of opinion that, under the same training and domestic conditions, the English and the German workmen are very similar. For instance, he has a number of men in his department whom he does not think he could match in England; they are of his own bringing up, and thoroughly efficient and trustworthy. On the average the German workman is distinctly inferior to the Englishman. He has not been trained to work like the Englishman. He is easy-going and forgetful, has neither the go, nor the resource of the Englishman, does not work with the same energy and does not get through the same amount of work. He does not live so well, and this is a far more important point than we Englishmen are apt to believe. But, with men under the same conditions of workshop training and food, his experience leads him to believe that there would be no superiority in the Englishman.

Education of workmen.

On the question of education, the Englishman is altogether behind. Mr. A.'s education, which was superior as a youth to that of most English workmen, or he would not have been appointed to his present position, had been lamentably deficient, compared with that of young Germans; and his sons, in the common schools, have received an education which they could not possibly have obtained in England.

Germany surpasses England in the matter of education.

The one point in which Germany is overwhelmingly superior to England is in schools, and in the education of all classes of the people. The dense ignorance so common among workmen in England is unknown. The Germans can all read, write, cypher, and, as a rule, draw; the young men continue their education in the Fortbildung and Sunday schools without leaving home, or losing time, or spending anything.

Industrie schools turn out good apprentices.

He strongly approves of the "Industrie" schools (described p. 97). Several boys have come from the Industrie school of the town to his department in the works, and he has been delighted with them. Instead of being raw, ignorant lads, unable to drive a nail or to use a file, they can begin work at once; they

have been taught to use their hands; and most of them have excellent ideas about work. How different from English middle-class boys that he has met with! He gives a decided preference to boys who have had a little workshop practice at school. He cannot speak as to their literary attainments; but they begin their workshop life with pluck and confidence, knowing the why and wherefore of things, and merit the respect of the older workmen. He pointed to a youth under him now, who makes sketches and drawings and calculations for him, and carries out his instructions like an experienced draughtsman, and this youth is no exception to the boys from the Industrie school.

Educational needs of England.

Though living in Germany so long, he has lost none of his love for his own country. He has long seen England's deficiencies in the way of education; he has never failed to proclaim them in numerous visits to England, and is glad that, through the awakening of the English people on the education question, there is the possibility of a remedy.

"Give the English workman the same schooling as the "German," remarked Mr. A., "which will improve him both as "a mechanic and as a man; keep him from soldiering, and "teach him to avoid drink, and no workman in the world will "have a chance against him."

German theoretical instruction should be combined with English workshop practice.

The German system of education, in which the sciences underlying mechanical industries are taught, combined with the English system of workshop practice, form his ideal of the training for an engineer, mechanic, or builder. England must not be content to rest on her undoubted superiority in workshop appliances and organisation; she must master the theoretical as well as the practical. "Keep to your shops," said Mr. A., over and over again, "and follow the Germans in scientific teaching; "English industries will then take a new lease."

English competition feared.

Mr. A. stated that every movement for the improvement of German industries was influenced mainly by the desire to strengthen their position with regard to the rivalry of England. They magnify the industrial advantages of England, and consider it impossible to compete with the English on equal terms. They hold to protection in the belief that they are hopelessly handicapped against English rivals, and that under a system of free imports, their markets would be flooded with English goods, and their own manufacturers and workpeople ruined.

Prosperity of trade after the war led to unjustifiable extension of works.

The abnormal prosperity which succeeded the Franco-German war led, as in England, to unjustifiable extensions of manufacturing works, which increased the intensity of the depression which followed. Mr. A. stated that when complaints were being constantly made in English newspapers that trade had left England and gone to the Continent, the suffering artizans of Germany could not be made to believe otherwise than that

England had wrested the trade from them, and that their difficulties were caused in a great measure by English competition.

Engineering and Mechanical Industries, Saxony.

Engineering works in Saxony.

Equal, if not superior, in importance to the mechanical industries of any other German States, are those of Saxony, and in no country has education, having especial application to industrial operations, been more extensively provided or more effectively administered. The town of Chemnitz affords ample evidence of great commercial and educational activity, and all the leading schools, and several of the more important manufacturing establishments, were visited by the Commissioners.

Importance of Chemnitz as a manufacturing centre.

The importance of this town as a centre for engineering and machine making, may be ascertained from the fact that there are in it 46 concerns for the construction of general machinery, 10 for making looms, and three for hosiery frames, making a total of 59 establishments for the construction of machinery.

The State railway works of Saxony were removed a few years ago to Chemnitz, adding 5,000 inhabitants to the population of the town.

Works of Messrs. Hartmann & Co., Limited, Chemnitz.

Engineering works of Messrs. Hartmann & Co., at Chemnitz.

Through the courtesy of the managing directors, the Commissioners were conducted over the extensive works of Messrs. Hartmann & Co., Limited, where 2,900 men are employed in the construction of locomotive and stationary engines, as well as of cotton, woollen, and other textile machinery.

Hours of work.

The regular hours are 10 per day, but at the time of our visit the men employed in the engine department were working overtime till eight at night, such was the demand for locomotives.

Wages of operatives.

The wages of mechanics average from 4*s.* to 5*s.* per day for piece work; other artisans are paid in proportion.

Training for apprentices.

Apprentices begin at 14, and although they are not bound, and do not go through any prescribed course of training in all or in any of the departments of the works, yet it is understood that they remain till they are called away for military service. In this sense only, may they be considered as apprentices.

Education of apprentices.

From 14 to 16, all these youths attend either the Fortbildung school or the one organised by the Operatives' Societies, and on two evenings per week they are allowed to leave the works at 4.30 so that they may attend the school at 6 o'clock. In the light of English customs, this is a great concession, and an illustration of the advantages expected by this firm from the theoretical training of these operatives.

Apprentices compelled to attend technical school.

On a previous visit to this establishment 10 years ago, by one of the Commissioners, he was informed that for many years previous, it had been a condition of the firm that apprentices should attend the classes of the technical school. It appeared that the custom was not confined to one establishment, as there were also students in the school from other large machine shops of Chemnitz.

Machinery, English tools.

Throughout the works, the tools and machinery were of a high class. Many of the tools were imported from England, and their superiority over all others was willingly acknowledged.

Condition of employés in Messrs. Hartmann's works.

The workmen generally, seemed to be intelligent and healthy, but according to evidence which we received from competent judges, familiar with rival industries in England, most of them do not get through the quantity of work in a day that an Englishman can. We heard the same statement almost invariably at works of this character, but were unable to submit it to any fair test. There seemed at times to be a disposition on the part of foreign employers to account for a cheaper product in England by leaping to the conclusion that English artisans work harder than their own, just as English employers attribute successful foreign competition to the low wages and longer hours of foreign workmen, neither party considering how many conditions besides hours, wages, and hard work, combine to make a cheap or an attractive product. It was considered by the manager that the supremacy of English over German artisans is gradually being overcome. The higher wages now paid as compared with former times, are expended on better and more nutritious food, so that the workman is found to possess more strength, energy, and endurance. In some exceptional cases, it was said that higher wages have led to excess in drink, though not nearly to the same degree as in England. Taking into account the amount of time lost by many English mechanics through drink and other excesses, and the infinitely greater steadiness and regularity of the Germans, he was of opinion that although the wages here are nominally lower, yet they will be found to be, on an average, nearly equal to the earnings of English mechanics in similar industries.

Opinions on the school-training of engineers.

In Chemnitz, as in other industrial centres, we came in contact with the leading employers and engineers, who freely gave their opinions upon questions relating to the education and training of men of their class. There were differences of opinion in matters of detail; some gentlemen of high authority and large experience were in favour of teaching the use of tools in elementary schools, continuing this workshop practice in more highly equipped technical schools, and thus preparing the engineer, by the union of theoretical knowledge with its application at the bench, for actual practice without apprenticeship. Others were opposed to the introduction of machinery into schools, beyond such models as would be useful for the illustration or demonstration of scientific principles, and preferred leaving the actual

teaching of the trade *entirely* to the workshop. But the advocates of both systems were agreed as to the great importance to all young men qualifying as engineers, of attending night schools, or by other means acquiring a knowledge of mathematics, applied mechanics, and mechanical drawing, at the same time that they gained workshop experience.

English and German engineers compared.

In an important conversation with one of the chief engineers of Saxony, some forcible opinions were expressed on the comparative merits of the English and German systems of training. This gentleman, whom we will designate as Mr. B., a German, of extensive experience, having spent many years in England and America, was thoroughly conversant with the industrial systems of those countries, as well as of Germany. He was of opinion that the English system of training an engineer for the duties of foreman or manager by leaving him to take his chance in the workshop, was quite as good as the German school system which aimed at the same object by more theoretical methods, and judging from the men trained by each method, he would not give the preference to the German. The Englishman who had taken pains to learn his business, was complete master of every detail of shop work. His daily experience brought him into contact with all kinds of practical difficulties, which sharpened his wits and his powers of resource. It must be admitted, however, that he was generally deficient in the higher scientific knowledge of his calling.

German engineer theoretically trained but deficient in practical knowledge.

The German school-taught engineer was strong in the knowledge of the principles of mechanics and physics, and in mechanical drawing. He was, however, deficient in workshop practice, and in the knowledge of men; qualities which could only be acquired by experience. And since nine out of every ten engine and machine shops were engaged upon stereotyped machines made according to pattern, it was more important to have an overseer who knew thoroughly how the work in hand should be done, and how to manage the artisans under him, and who could thus secure the end that all were striving for, viz., a cheap and effective machine, rather than to have an overseer who understood principles, which he had no opportunity of carrying into practice, but was inferior in practice and in the power of getting cheap and effective work out of his men. Mr. B. was of opinion that the English system erred in the direction of too little theory; the German system in that of too little practice. Of course, he would admit that a man could not have too much practical or theoretical knowledge, if it were possible to combine them, but so long as a man's training was limited by its cost in time and money, he was strongly of opinion that it was not advisable to run the risk of sacrificing practice to theory. The new schools of engineering in Germany, and particularly the Higher School at Chemnitz, were modifying their courses so as to secure adequate theoretical

training, with as little sacrifice as possible of that equally important experience which could only be obtained in the workshop.

Ideal training for an engineer.

On being asked what education he would recommend for a boy intended to become an engineer, Mr. B. replied that a workman's or foreman's son should, if possible, attend school until he was 16, and get as good a general education as was attainable in the time, including drawing and the elements of natural science. Then he should go to work, and attend evening classes in drawing, mathematics, applied mechanics, steam, &c. If the boy had anything in him, with such a preparation, he would assuredly get promoted, and under any circumstances he would be qualifying himself for superior work and higher wages, as was the case with many of the apprentices who were then going through the machine shops of Chemnitz. The sacrifice of the two years from 14 to 16 was well worth while, because it gave the boy a grasp of scientific knowledge, which the boy who left school at 14, even with attendance at the Fortbildung school, had no chance of obtaining.

Course to be similar where wages are no object.

Even an employer, or a parent not requiring his son's earnings, and able to keep him at school, could not do better than begin on the same lines. Let him enter the workshop at 16, and attend the night school until he was 18, at which age he would be ready to take advantage of the full three years' course of engineering at one of the higher technical, or Polytechnic, schools.

Danger of theory without practice.

A purely theoretical education up to 20 or more, left the youth, as a rule, too old for anything like hearty or enthusiastic work at the bench, and educated lads were sensitive about displaying their ignorance in this respect. Illiterate workmen, who would always be found in every shop, exulted over the failure or clumsiness of those who were looked upon as their superiors.

Training of head draughtsman.

Mr. B. instanced the head draughtsman at the most important works in Saxony, who had never attended a Polytechnic or Higher School at all, and yet was one of the cleverest men of his class in Germany. He had worked in the shop from boyhood, but having received a sound elementary education, was able from books, private tuition, and the daily experience of life, to master the difficulties of his calling as they presented themselves, and thus to obtain a superior practical education, and a position of eminence and responsibility. It is worthy of note at this point, although mentioned elsewhere in this Report that the head draughtsman at the great Creuzot works in France (where 80 draughtsmen are employed by one firm), presents another illustration of a similar training. His only theoretical instruction was that which he obtained at the elementary schools of the works, provided by the firm for the children of all the workmen.

The Iron Industries of Westphalia.

Visits to Westphalian ironworks.

The iron industries of Westphalia, based on its magnificent bituminous coal-field (which now produces about 20 million tons of coal per annum), including the great steel works of Krupp, have been so frequently described, that we shall confine ourselves to some details bearing directly on the subject of our inquiry. One of these is that the Thomas-Gilchrist modification of the Bessemer process for converting crude phosphoretic iron into steel, has been adopted in Westphalia and other iron districts of Germany, more generally than in any other part of the world.

Under the able direction of Herr Bueck, the Secretary of the Association of Manufacturers of the Rhine province and Westphalia, the Union Works at Dortmund were visited, as an example of the iron and steel works of Westphalia; the works of Mr. Krupp, of Essen, having been seen by members of the Commission on other occasions.

Apprentices.

As in English ironworks, they have no apprentices at the Union Works, and they prefer not to employ boys till they are 16 years of age. A boy when he enters is put to the work that needs "hands," whatever that work may be, and as soon as possible he is paid by piece. If he joins a gang, as generally happens, the directors cease to know what wages he may be paid; his share of the earnings is regulated by the men, according to his age, strength, and their estimate of his value. In separate work the boy comes under a general rate, and as soon as he can do a man's work he gets a man's pay, however young he may be.

Evening schools.

Great importance is attached to the attendance at evening schools, of all boys employed in the works. It would be considered in England that a boy who had gone through the strain of 12 hours piece-work among the furnaces of an iron-works, would be entitled to all the relaxation he could get in the evening. It is not so at Dortmund. The directors of these works require all boys under 18 to attend the Fortbildung schools of the town on two or three evenings a week, and the boys are required also to attend the Sunday schools. (As we have already explained, the reader must understand that the Sunday schools of the Continent, so frequently referred to in this Report, are not schools for religious teaching, or connected with religious organizations in the same way as those of England. They are invariably public, municipal, trade-guild, or State schools, intended for supplementing the education of the day school. Many are advanced schools, strictly technical in their aims, giving instruction in science and drawing bearing upon the local industries). At these works a register is kept of the attendance of the boys at evening schools, and is daily examined by an overseer in charge. Willingly

co-operate with employers in securing the attendance of apprentices at school, and we were told that the boys generally appreciate the schools, and make substantial progress.

The expenses of the Fortbildung schools are defrayed by the town. They are held in the municipal day schools building, and day school teachers conduct the classes.

Training of heads of departments, Union Works.

The managers have received the usual German technical training, are thoroughly familiar with English works, proficient in the English language, and constant readers of English engineering and metallurgical journals.

Chemists employed.

Two chemists are employed for testing minerals and superintending the charging of the blast furnaces. One of these chemists is a gentleman of distinguished reputation, and both had been Polytechnic students. The leading draughtsmen had also been educated in Polytechnic schools.

Schools for foremen.

Besides a school for mining-deputies at Dortmund, a "Werkmeister" school has been quite recently formed at Bochum for the special education of foremen in ironworks. It is supported entirely by the iron manufacturers, who contribute in the ratio of the number of men whom they employ. No man is admitted unless he has been four years at work in some branch of the iron industry, and has shown superior capacity and conduct. The students go through a course of practical metallurgy and of the other sciences bearing on their trade. (*See* p. 117).

Difficulty of obtaining properly qualified foremen.

One of the directors of the works, who takes great interest in the school, stated that at present it was exceedingly difficult to find scientific knowledge and workshop skill and experience, united in persons of the class of foremen. Trained simply in the works, they necessarily knew but little of the sciences of metallurgy and chemistry. The Polytechnic students, who had mastered the sciences were often useless in the works. It was the intention of the school to engraft some knowledge of principles on the practical skill of the workmen.

Comparison between systems of training in England and Germany.

The director expressed a strong opinion that the works-training in Germany is less thorough than that of England. If any country could claim natural aptitude for a particular industry, England might fairly claim pre-eminence in iron. Germany cannot look back upon generations of skilled and practical men; the stimulus of high rewards directing talent to mechanical pursuits; the boundless capital at command to develope inventions: and until lately Germany has not been able to match the men of talent who, from time to time, have arisen in England to revolutionize the trade. A combination of circumstances, has long helped to strengthen England in what had been so long, but was now no longer, her great iron monopoly. For many years, the best that other countries could do was to follow; and, in strengthening their weak places, they were compelled to look to education as their most important

aid. Let education, said the director, be sound and thorough, so far as it goes. If a boy must leave school at 14 or 15, in order to earn his livelihood, there is no good in teaching him a great variety of subjects. Give him as far as the time will admit of it, the tools which will enable him, as opportunities arise, to dig knowledge for himself. A smattering of many things does not make a boy clever, but often makes him conceited; it persuades him that he is intended for something better than swinging a hammer or using a file. If a man must earn his living by his hands, give him an education that will help him to do it; teach him drawing, the rudiments of science, modelling; ground him well in arithmetic. There is no good in a working boy receiving a "fancy" education at somebody else's expense, when that education rather hinders than helps him in his work. If, on the other hand, a boy has exceptional talent, by all means cultivate it, and do not grudge the cost in public money, for the public as well as the boy will reap the advantage of it.

Steadiness of men.

The director had often visited England, and had had many opportunities of forming an opinion of English workmen. He was not prepared to say that the English workman was superior to the trained German, in the iron and steel industries. They can place the greatest reliance on the attendance at work of their men. Absences without leave are exceedingly rare. The workmen, among themselves, insist upon regularity of attendance, in order to keep up the requirements of the gang. The "Saint Mondays" among ironworkers in England are unknown here; on Monday morning, every man is at his work as punctually as on any other morning. The day previous to our visit was Whit-Monday, a general holiday, and the trains, railway station, and streets of Dortmund were full of holiday people. The director would guarantee that not 12 men out of the 3,000 employed at these works were absent to-day (Whit-Tuesday) from causes that were not fully justifiable. No better testimony could be given of the discipline and good conduct of the men generally.

Rational enjoyment of men during holidays.

Generous testimony was also borne by one of the directors as to the behaviour of the working population at holiday times. He said that all classes are almost passionately fond of music, and thoroughly enjoy a concert. There are some woods belonging to Dortmund, at a short distance from the town, and steam trams run between the two all day long. He had taken his family to the woods on the previous day, and found many of his own workmen there, who had taken food and coffee and wine, and were picnicing with their families. There were two open-air concerts in the woods during the day, and among the thousands present there was not the slightest impropriety; all were enjoying themselves in a rational manner.

Drunkenness is very rare.

There is very little drunkenness among the men in the works. Occasionally a man gets "over the line"; but the company will not employ men who are habitual drunkards. There are

very few men who spend much money in drink; in fact, it is considered a great disgrace for even the poorest of the men, to neglect their families.

The men are allowed to drink beer at their work, contrary to the custom in other works, and it is even sold to them on the premises by permission of the company. After a Bessemer blow, quite a rush was made to the small office where the beer was served. The beer is light and wholesome, and the directors did not think that it impeded the work of the men. We have not heard this opinion of English beer by English employers; of course it will be understood that the German beer is altogether a different beverage from the English.

Sick Societies, but no Trades' Unions, Dortmund.

We did not hear of any Trades' Unions. There are sick and benefit societies to whose funds the workmen subscribe largely. The funds are used for the purpose of subsidising the men in cases of sickness, but not for what are understood in England as "trade objects."*

Cottages.

The company own a colony of cottages, which they let to the workmen at low rents—about 6*s.* a month it was said, which covers interest on capital at a low rate. Many of the men dwell in their own cottages, and a very large proportion have money laid by in savings banks, or invested in other securities.

Co-operative society.

There is a large and important co-operative society connected with the works, and managed in a great measure by the men, but the capital is mainly supplied by the company. Everything in the shape of food and clothing is supplied at cost price, or at so much more only as covers the cost of management. We were informed that under this arrangement an enormous saving is made, as compared with the system of retail buying at the shops.

Gardens.

Many of the men have garden plots, and they work in them at night, growing vegetables and flowers. The directors spoke highly of the good influence of a small garden. The occupation makes an agreeable and a healthy change, bringing the workman into the open air, improving his tastes and habits, and acting generally as an inducement for keeping him at home in the evening.

Military system.

The remarks made to us by one of the directors on the military system, were especially interesting, because while they were so much at variance with those of other competent authorities, they were expressed with equal emphasis. He had not been through the service, and therefore, as he said, was unprejudiced. He believed that the advantages of military service altogether outweighed the drawbacks. For iron-smelters, puddlers,

* A law compelling insurance and whic[h] 'n on the 1st December 1884 and the 1st January 1885, was pas[sed]

moulders, millmen, and other iron workers, he did not think that the three years' military service diminished the powers, or the manual dexterity of the men.

Men who have been in the army preferred.

Of two applicants for employment, in other respects equal, one of whom had gone through military service and the other not, he would choose the soldier. He could in going over the works at once pick out the man who had been a soldier, and was pretty sure to find him a superior man in consequence. But, he continued, there is all the difference in the world between citizen soldiers and professional soldiers. His encomiums related entirely to the former class, in whom service tends to foster patriotism, and a spirit of self sacrifice. It steadies them, shows them the serious side of life, and both in work and in social matters increases their *esprit de corps*.

It must be remembered in comparing the opinions of this gentleman and those of, say Mr. A. (page 336), that the experience of the latter related entirely to the mechanics' shop, and to men whose work requires great manual dexterity, whereas the work of the metallurgical establishments carried on here, involves co-operation in gangs, which is greatly promoted by the discipline of military drill. There is necessarily a considerable difference between the qualities required in the case of a practical working engineer, and in that of an ironworker.

We have given prominence to both these views, as to the *effect* of the military system upon the workmen. It is however only fair to say that we found no difference of opinion as to the *cost* and *inconvenience* of the compulsory absence of the workman from his work and his home during these three years of service, which in England would be considered as among the most important in a young man's industrial career.

Workpeoples' Societies and Factory Regulations.

Benefit societies in connection with manufactories on the continent.

On the continent it happens more frequently than in England, that associations exist in the different factories, for conducting not only sick and benefit societies, as with us, but also for managing savings banks, co-operative stores, and agencies for the promotion of education. Employers also oftener exercise paternal control over their operatives, of whom they require strict adherence to rules that seem to go beyond the requirements of ordinary factory discipline. In some few instances we found exceptional provision for the comfort and enjoyment of the workpeople. As an example we may quote the works of Herr Franz Brandts, of Gladbach, Rhenish Prussia. From 300 to 400 hands are employed in the cotton manufacture. Attached to the factory is a beautiful park and garden, in the centre of which is a handsome chateau, which

Manufactory of Herr Franz Brandts, Gladbach.

St. Josephshaus, Gladbach.

is used, for the purposes of infant school for the children of operatives, as dining-rooms, reading room and library, concert-room, and as a chapel for devotional services. On the basement there are kitchens where dinners are prepared daily for nearly 100 operatives. The co-operative principle is adopted, and to promote economy, the workpeople wait upon each other, taking turns week by week. A substantial dinner of soup, meat, and vegetables, is served for 3*d*. There is music and singing twice a week, and four times a year there are concerts—in the open air in the summer time—which are largely attended. A priest conducts religious services and gives spiritual advice to the workpeople before six o'clock every morning.

Served as residence of proprietor.

The upper rooms of the château are well furnished, and are occupied in the summer by the proprietor and his family. It is in contemplation to provide a number of sleeping-rooms, in the second storey, for girls employed in the factory who have no parents or guardians. The gardens attached to the mill are beautifully laid out, and vines, peaches, strawberries, and cherries, besides flowers, are extensively and carefully tended by the operatives. Under the trees and opposite the fountains and flower beds, there are seats where the people sit during their mid-day rest. There are baths and washhouses for the use of the operatives.

Baths and washhouses.

Besides educational provision for the children, "every female "under 18 years of age is required to attend the sewing school "once a week," one hour and a quarter being allowed from the factory time for this purpose.

Moral regulations.

By the printed "moral regulations," the overseers, and all in authority, are enjoined to set a good example to inferiors, while the workpeople are admonished to maintain decency in their outward appearance, and respect towards each other. "Unmarried young people who live away from home against the "wish of their parents, will be dismissed at once." Wages are only paid to minors with the permission of their parents, and even in the case of unmarried male and female workpeople who are of age, the firm reserves the right to pay the wages to the parents. Female workers are separated from the male operatives during work as much as possible, and the two sexes take their meals separately. Married women, and children under 14 years of age, are not employed.

Sick fund.

All operatives *must* contribute to the sick fund, which includes provision for the families; it is managed by a committee of workpeople, and the principal subscribes 50 per cent. of the total contributions. On the birth of a child, an allowance of 10*s*. is made to the family from the fund. There is a mutual benefit society, for advancing money for the purchase of food, clothing, and furniture, &c. If through illness or misfortune, workpeople get into difficulties, advances are made from this fund for their assistance, rather than that they should be required to break into their savings.

Mutual benefit society.

In this factory the total working hours in the week are 62, and young persons are allowed two half-hours a day for recreation and open air exercise. Wages are paid by piece. Weavers earning 13*s.* a week receive a premium of 9*d.* The premium ascends according to scale to a maximum of 2*s.* per week to weavers earning 21*s.* or more. Working hours. Wages.

Industrial Society of Mulhouse.

Among the voluntary agencies which, in Alsace, have promoted technical education, stimulated manufacturing industries, and united employers and employed in good fellowship, the Industrial Society of Mulhouse must ever be considered the most important. Industrial Society of Mulhouse.

It was founded by the manufacturers themselves in 1832, and its entire influence from that time has been exerted for the welfare of all classes in the town and neighbourhood. One of the leading citizens spoke of its influence in terms of the highest praise. "It has supported education, encouraged and "protected inventions, provided courses of lectures, founded and "erected a museum and galleries of science and art, promoted "the efficiency of the local manufactures, strengthened the "bonds of amity between masters and workmen, and exercised "a most benevolent concern over all classes." Founded in 1832.

The objects of the society are described in Article I. of its statutes as follows:—"The Industrial Society aims at the "advancement and the encouragement of industry, by bringing "together in a central position a great number of facilities "for instruction; by the communication to its members of dis-"coveries and remarkable facts; also by the developments to "which they have given rise; and by all the means which can "be suggested by the zeal of the members of the association for "assuring its success." Objects of the society.

The society has a president, three vice-presidents, a secretary, assistant secretary, steward or manager, and two librarians. For carrying out its objects, there are committees classified under the following heads:—mechanics, chemistry, natural history, fine arts, commerce, public utility, history and statistics, and industrial questions. Officers.

There are from 600 to 700 members. Annual members pay 2*l.* 8*s.* (60 francs) a year; life members 40*l.* (1,000 francs). Members.

A remarkable evidence, not only of the popularity, but also of the stability of the society, may be gathered from the fact that its accumulated funds now amount to 160,000*l.*, given and bequeathed by the inhabitants from time to time, to be appropriated for the public good. The buildings of the society are Accumulated funds. Buildings.

situated near the railway station at the entrance of the town. They comprise offices, library, museum, picture gallery, lecture hall, and contain a fine collection of engravings, and modern pictures, museums of natural history, geology, &c., specimens of patterns, calico prints, cretonnes, &c., carefully arranged and very complete. This group of buildings, though extensive, is insufficient for the purposes of the society, and a large art gallery and museum, erected at a cost of 16,000*l.* to 20,000*l.* by subscriptions from the members and townspeople, is shortly to be completed.

New museum, Mulhouse.

Assistance to inventors.

The several committees receive memoirs and papers on discoveries and inventions, and report thereon at the general meetings of the society. A poor inventor can submit an invention to a qualified committee, who assist in perfecting it and in introducing it to the trade, securing due interest and benefit to the inventor.

Educational work of the society.

The society initiates and patronises undertakings for the public good, and has raised large sums of money for such purposes. It has founded, or materially helped, all the institutions for higher education. It fostered the School of Chemistry, the Spinning and Weaving Schools, the Professional School, the School of Design, the Engraving School, and the School of Arts and Trades for Jews, and other institutions of high educational importance.

General work of the society.

There are very few matters of social or industrial interest that escape the attention of the society. Schemes for improved dwellings have been considered and carried out on a large scale, with highly satisfactory results. Discussions on thrift have led to the provision of savings banks, benefit societies, and kindred institutions. The food supply has been cheapened by the establishment of co-operative stores, and rendered more pure and wholesome by energetic measures against adulteration. Public morals and health have been benefited by the substitution of lectures and concerts for less decorous amusements. The death-rate has been reduced, and pain alleviated by the care and assistance of indigent women in childbirth. A special society has been promoted for the protection of workpeople from accidents by machinery. Medals and other prizes are given in recognition of services to the public welfare, and the reports of the proceedings at periodical meetings are published, with particulars and drawings of machinery and other objects of interest to the members.

Reading room.

The reading room is furnished with the leading European magazines bearing on science, commerce, &c., among which we saw a greater number of English industrial and scientific magazines than are often found in the reading rooms of many of the larger towns in England. The library is rich in works of reference relating to the industrial arts, and is supplied with all important new works as they are published.

In making a hasty tour of the rooms we were shown a cabinet of physical apparatus, and an important collection of dye-stuffs.

Collection of patterns.

We were greatly impressed by the superb collection of cretonne patterns and other specimens of calico-printing. A large number of cases in one room contained the selected examples of the best makers in all countries. There were also cases and boxes of smaller patterns, all selected because of some superiority or novelty of design. A magnificent collection of local prints was shown to us, prepared in 1876 for an exhibition celebrating the jubilee year of a society of calico-printers established in 1826. In addition to the above, there is in the town a public museum of prints and textiles, assisted by this society to the extent of 240*l.* a year (described, page 353), and containing probably the most extensive and valuable collection in the world.

Art collections.

The picture gallery contains a choice collection of modern paintings, most of which have been presented by the members. There is a special collection, less important in itself, but interesting as being composed entirely of the works of Alsatian artists. There is a charming collection of etchings presented by a townsman, M. Engel Dollfus, valued at 80,000*l.* One small etching by Rembrandt, of three trees, is said to be worth 200*l.*

A donation of 16,000*l.* in money was made to the society by Mr. Haeffely.

Museum and gallery of casts.

The museum of animals, birds, insects, &c., and minerals, is extensive, and there is also a gallery of casts of ancient statues and other antiquities.

Concert hall.

The spacious and handsome Hall for concerts, lectures, conversaziones, &c., is largely used by the inhabitants. The museum and the picture galleries are open free to the public on Wednesdays, Saturdays, and Sundays, and on the latter days in particular they are largely attended. The popularity of the museum and galleries among the workpeople, has done much to encourage the building of the new art gallery.

Voluntary character of the work of the society.

One remarkable feature of this society is the voluntary character of its work. Mulhouse is the only town which we visited on the continent, where such extensive buildings have been erected for the general good, entirely by local subscriptions. The society receives no State aid, and does not want any. We were informed by M. Auguste Dollfus that some years ago, General Morin offered the society a subvention of 200*l.* a year, which the members declined, desiring to preserve their independence and to trust to their own public spirit. The society is very favourably alluded to in the report of the French Commission on technical instruction of 1864. Referring to a proposal to re-establish the literary and scientific lectures that were successfully commenced 30 years before that time, the report goes on to say—"Then the city of Mulhouse would

" possess a system of educational establishments of every degree; " infant schools, primary schools, adult schools, a school for " drawing, one for weaving, one for spinning, a Hebrew school " of arts and trades, a professional school, a college, an upper " school for the applied sciences, public classes, and a popular " library, literary and scientific lectures, all founded and kept " up on their own resources, without any help from the State " other than a purely moral co-operation." It is satisfactory to find that the aspirations of 1832, so favourably reported upon in 1864, have for many years been practical realities, and that they have contributed in no small degree to the elevation of the town of Mulhouse to a front rank among continental cities, in everything that concerns the enterprise, public spirit, and prosperity of its inhabitants. Probably Europe does not present a similar combination of educational agencies, so complete, in a purely manufacturing town.

Workmen's City, Mulhouse.

Workmens' city, Mulhouse.

As connected with the labours of the Industrial Society, and the social life of Mulhouse, we would notice very briefly the "Workmens' City" which we visited with great interest. This "*cité*" consists of 1,000 or more freehold dwellings belonging to workmen, who pay for them on a system organised by the Industrial Society, analogous to that of building societies in England. The instalments are paid weekly or monthly, and extend over a period of 15 years. The cottages are built in groups of two or four, each containing two small rooms downstairs, and the same upstairs; they cost about 160*l.* each, including a plot of garden attached to each dwelling. The society buys back cottages, when owners wish to dispose of them, as often happens on removals, &c., and makes repairs at cost price. In connection with the cottages, a block of wash-houses, an infant school, a cheap restaurant, and some co-operative food stores have been erected.

Tramway.

The town tramcars run along the main street of this colony, giving rapid and frequent communication with the centre of the town and the leading factories.

Arrangement of a cottage.

In one of the ordinary cottages to which we were conducted, there was a small kitchen or scullery, a small room, used in this instance as a nursery, and a larger living room. There were two rooms and an attic upstairs. The cellar was divided into three rooms for coals, lumber, and pantry. There seemed to be a tendency in all these dwellings to provide very inferior bedrooms, almost invariably in the roof, with one or two panes of glass for light. The stairs were little better than a step ladder. The cooking apparatus in the kitchen seemed to be fairly

efficient and convenient, with hot water pan and tap, but no oven. Economical arrangements for boiling water and fixing cooking pans seemed to be well understood and appreciated.

Outside many of the rows of cottages, about three feet from the doors, a stream of water ran along an open gutter, intended, we presume, to take away the sink and slop drainage. The water was dirty, and the smell somewhat offensive, but probably the system is effective as avoiding the serious dangers which arise from sewer gas. The garden plots in front of the houses varied very considerably in appearance. Some were highly cultivated, and showed evidences of future beauty. A profusion of flowering plants was here and there to be seen about the windows. Drainage.

We inspected the infant school, wisely placed in the midst of these workmen's houses, so that the children can begin their school discipline at an early age without the danger of traversing crowded streets. We heard the children sing, saw them march, and go through kindergarten and gymnastic exercises as well as in similar schools in England. Infant school.

Museum of Textile Fabrics at Mulhouse.

The museum of textile fabrics was founded by a society of designers in 1858, but since 1873 it has been the property of the Industrial Society. The great bulk of the collection of patterns was presented to the society by M. Schönhaupt in 1858, and, as we have said, the society retains in its own central rooms an important collection of patterns in addition to those exhibited in the above museum. It contains a complete series of patterns of calico-printing from the commencement of the trade in this district in 1746, to the present time. There is a permanent exhibition of historical specimens of ancient textiles in cotton, silk, and wool; specimens of tapestry printing have been contributed by Messrs. Thierry, Mieg, and Co. It is intended to enlarge the museum so as to form a still more important historical collection. Museum of textile fabrics at Mulhouse.

The room is divided by a number of fixed screens, leaving a passage down the centre, and forming eight large compartments on which the designs are displayed. The framework of the screens is substantially made, and the historical specimens and those representing the textile industries of old countries, such as India, China, &c., are appropriately mounted and tastefully arranged. The new patterns for each year are fixed against covered screens, and are labelled, with the names of the producers, from Paris, Germany, England, or elsewhere. Against the walls of the room are cabinets filled with designs, and surrounding the room are tables, on which the patterns and books that Arrangement of the museum.

are stored in drawers and cupboards below, can be conveniently placed for study and reference.

Patterns preserved in books.

In due time the designs on the screens are removed in order to make way for more recent patterns, and are then mounted in books, catalogued, numbered, and put away in a library. We were informed that from 1829 to 1858, the patterns considered worthy of being preserved fill 380 large volumes.

Influence of textile museum on the local industry of Mulhouse.

In conversations with some of the leading manufacturers we were informed that the museum has exerted a most important and beneficial influence upon the leading industry of the district. Some went so far as to say that they could not see how the trade could in any degree prosper without it. To the designer it is a constant source of inspiration. The museum is to him what the well-stored library is to the literary man, or a collection of the best pictures to the painter. It cultivates and raises the taste of the ordinary visitor, sharpens the wits of the manufacturer, and is a constant register of the relative progress of the competing countries in manufacturing enterprise. It gives invaluable assistance in suggesting the adaptation of old or historical styles to current wants. Taste is constantly changing; fashions come up again after being long discarded; the demand may run on Indian, Persian, Chinese, Italian, Spanish, or the French style of one of the Louis; but whatever may be wanted, the trade comes most rapidly and most profitably to those who can adapt or harmonise the ideas, forms, colours, and conceptions of the past, if the forms of the past are asked for, with the prevailing wants and notions of the present. When it is remembered that a taking design not unfrequently makes the fortune of a firm, and that the invention of a new colour, a superior "finish," or a better adaptation of machinery for the production of tasteful fabrics, often raises the industrial character and increases the wealth of a neighbourhood, the value of such a museum can be rightly appreciated.

Cotton Spinning and Weaving, Belgium.

Cotton spinning and weaving, Belgium.

The cotton industry of Belgium is conducted under conditions very similar to those of France and Germany. It was not admitted anywhere that in the manipulative operations of spinning and weaving, any technical education beyond that of the factory had ever been sought after. English machinery and methods are everywhere adopted, and English competition is the despair of every millowner.

No Factory Acts.

In Belgium there are no Factory Acts; men, women, and children may work all night or as many hours in the day as may be agreed upon between them and their employers, without any interference on the part of the State. We were, however, frequently informed that in the cotton industry no children under 12 years of age are employed, and that in connection with many

of the large factories, are schools in which during mill hours a certain time every day is devoted to "continuing the education" of all boys and girls under 15.

Hours of work and wages.

As in France and Germany, the usual working hours are 12 per day, and most of the operations are paid for by weight or piece. Carders are usually paid by day, and receive about 2*s.* per day for men. Drawers, mostly women, about 2*s.* per day, by weight. Spinners; for one pair of mules there are usually one man, who earns about 5*s.* per day, and three boys, who are paid about 10*d.* a day each. Two-loom weavers earn by piece from 2*s.* 6*d.* to 3*s.* a day among the men, while the women earn from 2*s.* to 2*s.* 3*d.* on an average. Mill mechanics are paid by day, from 3*s.* to 4*s.*

Works of Messrs. De Parmentier & Co., Ghent.

During the visit of the Commissioners to Ghent, we were allowed to visit the factories of Messrs. De Parmentier van Hoegaerden & Co., by invitation of M. de Parmentier, who came from Brussels on purpose to conduct us over the establishment.

Over 2,000 workpeople are employed by the firm, and no children are admitted under the age of 12.

The mill buildings are well constructed; the rooms are wide, lofty, well lighted, and well ventilated; the weaving shed is of imposing size, and the arrangements generally have been carried out with prime regard to excellence of workmanship, convenience, efficiency, and economy of production. In these respects the works may be classed with the first-class cotton factories in England.

Engines.

There are three engines, all made in Ghent, with a total of 2,800 horse-power. The largest of these, a double beam, of 1,400 indicated horse-power, was doing its work with marvellous precision and steadiness; the engine-house is one of the handsomest that we have seen in any country, and the engineers' shop communicating with the engine-house, is a model of convenience, containing all the necessary tools, tackling, &c., for any difficulties that may arise. Coal costs about 11*s.* per ton delivered at the boilers, and is consumed at the rate of about one kilo. per horse-power per hour, which is very low, although the coal is decidedly inferior.

The power is carried from the main engine to the shafting by two huge leather belts, supplied by an English firm at a cost of 800*l.*

Training of head engineer.

The head engineer and director of the mechanics' shop, which contains an admirable set of machine tools, and gives employment to upwards of 40 mechanics, had worked in England, and was familiar with some of the large machine shops and factories of Lancashire. He received his education in a primary, advancing to a secondary, school, and, after some practical experience in a workshop, he went through the courses of the engineering department of the University of Ghent. After completing his education he came over to England, worked as a mechanic in an engineering shop, and spent eight months in the drawing office of

Messrs. Platt & Co., Oldham. He returned to Ghent, and, with two years' experience in this factory, mostly among the machinery in the various departments, he learned more of the principles of the business than, in his opinion, many a foreman learns in a lifetime. He attributed his superior knowledge, and the rapid means by which he had acquired it, entirely to his scientific education and his large experience in technical machine work.

Machinery imported from England.

Except the engines, we understood that the whole of the machinery, consisting of 150,000 spindles and 1,200 looms, had been imported from England. With duty, cost of transit, and extra cost of "setting up" added to the English price, the firm paid fully 25 per cent. more for it than they would have had to pay in Lancashire. The mules are from 700 to 900 spindles long, and the whole of the machines,—carding, spinning, warping, reeling,—and looms, were new and constructed on the most modern principles.

The work in progress in all the departments seemed to be thoroughly well managed. We noticed several different counts in the spinning, and many varieties of goods in the weaving, and were greatly impressed by the scrupulous cleanliness of the whole establishment.

School on the premises.

Although the employers are under no obligation with regard to school provision and attendance, a good school is provided on the premises, and attended for one hour a day by all young persons from 12 to 15. The boys and girls (usually separate) come in batches, as they can be spared from their work, and go through a course of teaching. There is no rule as to the age when school attendance shall cease, and, in the case of painstaking and attentive pupils, it often continues until they are 17 or 18 years of age.

Medical attendant.

We noticed placards in different parts of the factory stating that the medical man would be in attendance at a certain hour, and in one of the weaving sheds a painted board indicated that he was on the premises, and could then be seen by any of the operatives in that room desiring his advice. We were informed that a fixed salary is paid to the doctor by the firm, for which he gives free advice to any of the workpeople, and, in accordance with his prescriptions, filled up on printed forms, medicine is supplied by the apothecaries of the town at a reduction from the regular price of 25 per cent., the difference being made up by the firm.

Library in works.

At the lodge or time-office at the gates, is a library for the use of the workpeople, which is extensively used by the young people. The books have been carefully chosen with the object of supplying useful information and amusement.

Good feeling of workpeople.

Very favourable reports were given to us of the good feeling which exists between employers and employed at these works. The operatives seldom change situations, and many have worked for the firm during all their lives. At many of the works which we visited in Belgium, and, indeed, in all other countries, testimony

was borne to the friendliness and sympathy between masters and workpeople, but we had no reason to believe that in these respects either English employers or employed would suffer by comparison. It was our privilege to come in contact with the best types of all classes.

Appearance of workpeople.

When the engines stopped at the dinner-hour, we took the opportunity of noticing the appearance of the 2,000 workpeople who passed through the factory gates. Speaking generally, they looked healthy and well dressed, paying much more regard to outward appearance than would be found among cotton operatives in a manufacturing town in England. The men wore cloth coats over their blouses, and in many instances the blouses or smocks had been left behind in the factory, so that they did not carry many traces of their work away with them. The women were almost universally attired in bonnets and hats. They also wore long black cloaks, some of cloth, and some of serge or other heavy worsted material, which came to their heels and entirely covered their dresses. The cloaks were larger and more loose in shape than English ulsters, and most of them had hoods. The attire of the women, all in black, seemed somewhat akin to that of the Sisters of Mercy so frequently met with in Belgian towns, but it impressed us as being comfortable, cleanly, and serviceable.

Conversation on English versus Belgian hours of work.

In conversations with employers, politicians, and the representative men who favoured us with their opinions upon educational and industrial questions, the feeling was general that in view of the competition of England, and her great natural and acquired advantages, it was hopeless to expect that the hours of labour in the Belgian cotton industries should be lessened. As an accompaniment of general prosperity, wages from time to time may probably be advanced, just as, under influences of depression they will be reduced; but the margin of profit is always so small that a reduction of hours would take the trade hopelessly away and hand it over to English and other rivals. The substance of the general opinion on this question was, "reduced time means reduced output and increased cost." There were, however, exceptional instances of practical and experienced men, who had usually spent some time in England, and who entertained an opinion that reduced hours do not necessarily mean reduced work, even in the minding of a machine, and in touching upon this branch of our inquiry, it is but fair that such opinions should be given. One gentleman who had resided several years in Lancashire, and had devoted his life to the practical study of the cotton industry, expressed his views simply and clearly to this effect. He did not believe that there was any advantage in 12 hours as worked on the Continent, over 9½ as worked in England. From his own experience he had found that as much or more work is done in England in 9½ hours as in Belgium in 12. The English climate and the natural stamina of the Englishman contributed to this result, but he was convinced that if English factories were to run 12, instead of 10 or 9½ hours a day, although for a time there would be an increase of work, yet, in the course of

a few years, the energy and strength of the Englishman would diminish, and the quantity of work per hour would lessen. The English manufacturing population would deteriorate, and in a generation the cost of production would, in his opinion, be not one whit less than at present. On the other hand, if in Belgium the hours were reduced from 12 to 10 per day, a change would gradually come over the spirit of all their factories. The extra rest, the Saturday half-holiday, the pure air and change, particularly if accompanied with better food, would bring sunshine to the lives of their young people and strengthen the constitutions of Belgian workmen. Their physique would improve, and as stronger men they would apply themselves with extra energy to their work, and thus make up for the shorter hours. The difference in the time would be more than compensated by the increased pace, whilst the days of the Belgian cotton operative would be lengthened, and his happiness increased.

Woollen Spinning and Weaving at Verviers, Belgium.

Woollen spinning, Verviers.

Probably the most remarkable of the industries of Belgium, considered in relation to its influence upon the woollen trade of England, is the woollen yarn-spinning of Verviers. The Commissioners are indebted to Mr. David Sandeman, a merchant and yarn agent of large experience in Glasgow, and one of the first to offer Verviers yarn in this country, for some interesting evidence with regard to the use of this yarn in Glasgow. Reporting in 1873, he said, "About 30 years ago the manufacturers of Glasgow "were almost wholly supplied with woollen yarn by the spinners "of Yorkshire. Now the very reverse is the case, they are "mainly dependent for their woollen yarns upon the spinners of "Belgium and the Rhenish Provinces. It is difficult to get "reliable statistics of the proportion which the English spun yarn "bears to the foreign, but I may venture to give an opinion, that "not one pound of English yarn is manufactured in Glasgow for "every hundred of foreign. The cause of this cannot be attributed "to the Belgians and others having greater facilities for procuring "the raw material, the wool chiefly employed in the production "of the yarn being imported from Buenos Ayres, generally in "British vessels, and sold by auction at Liverpool, Havre, and "Antwerp for British account, so that our spinners can purchase it on fully as favourable terms as their competitors."

Mr. Sandeman's Report of 1880.

Mr. Sandeman, in reporting to the Glasgow Chamber of Commerce on this industry, in 1880, stated that the import of woollen yarn from Verviers to Great Britain "has risen from one and a "half million pounds in 1862 to fourteen million pounds in 1879, "employing about 50 spinning mills with an average of 10 sets "of carding engines in each. The superior treatment of the burry and ill-conditioned wool, and which for these reasons was neglected by us, has enabled the Verviers spinners to produce

" a suitable yarn at a lower price than we can do ourselves; and " their superior skill in the preparation of this wool, has given " them well nigh a monoply in the importation of it from Buenos " Ayres, so that it is remarked that manufacturers and dealers " from various countries in Europe come for supplies to Belgium " where no wool is grown." He states that it possesses no superiority over English yarn, " its low price is its chief recommendation." As to the reasons for its cheap production, there are many, " their superior treatment of the burry wool, and their long " experience at this industry, lower wages, longer hours, in many " cases working day and night, and being content with a small " profit." That the profit must have been in many instances *very small*, may be gathered from the following conclusion: " I must not omit to observe that some of the spinners in Verviers " have failed periodically, and it is only the few who have been " been able to hold on for better times who have made money."

Interviews with leading men.

The Commissioners visited Verviers at the end of November 1882, and in addition to seeing the schools, inspected some of the most important factories of the town. We were also favoured by interviews with the leading industrial representatives, among whom were M. Charles Mullendorf, President of the Chamber of Commerce, MM. Hauzeur, Gerard Fils, and Peltzer, from whom we obtained the fullest information as to the educational and industrial condition of the town. The population of Verviers is 41,692.

Hours of labour.

We were informed that the hours of labour vary somewhat in the different factories. A few work 11 and 12 hours per day, increasing to 13 and 14 in times of exceptional demand, but the overwhelming proportion of the factories work 22 hours per day, in two shifts of 11¼ hours for the day and 10¾ for the night. They begin work at 6 in the morning and continue till 7 at night, when the second shift begins, and continues with one quarter of an hour for rest and food, until 6 a.m. The short shift is on Saturday night which is 9 hours, as the machinery stops at 4 a.m. on Sunday, to allow time for the workpeople to rest, and the engines to cool ready for the start at 6 on Monday morning. It will thus be seen that the total hours for the week are 130. We were informed that the " hands " change fortnightly from the day shift to the night shift, and that the work, which is paid by piece, is shared by the two sets, who divide the product of the 22 hours. It appears that night-work is more in favour than day-work, because it gives an opportunity for those who are supposed to rest during the day, to work in their gardens and carry on other operations on their own account.

Employment of children.

As to the employment of children, there is no factory law, but by agreement among the employers, children are not generally admitted to the factory under 12, and the feeling of employers, we were told, is against child labour. They are of opinion that very early work tends to check the growth of children, and causes them to be stunted and weakly through life, and that it is better that before 12 they should have as much fresh air and schooling as possible. A few years ago an inquiry was made as to the

number of children of tender years that were employed in factories, and it was discovered that in the whole district only 51 under 12 were employed. Probably the number at present employed under 12 is smaller. There is no organised short-time system, and children are employed without any outside restrictions, but many employers of their own accord allow children above 12 to attend school during work hours. From our inquiries, we gathered that the children take their share with the men and women at night work as well as day work.

Wages, Vervier's.

Wages are paid fortnightly and by piece. The maximum for men spinners is about 3*s.* 6*d.* per day. Women at spinning, about 2*s.* a day. Carders and drawers, boys and girls at varied occupations, proportionately less. Weavers (men), earn from 2*s.* to 2*s.* 9*d.* per day, women from 1*s.* 6*d.* to 2*s.* 6*d.*, often as much as men, the rate being the same. Finishers, &c. (men) from 2*s.* 3*d.* to 2*s.* 6*d.* per day. We were told that wages do not seriously fluctuate, and that during the last few years the tendency has been upwards, without any intermediate lowering. Employers wished us to understand that in periods of temporary depression they do not lower the wages, and they also admitted that in ordinary good times they do not advance them; generally speaking, labour is plentiful.

Machinery.

There is no speciality in the machinery. Many of the carding engines are made in Verviers, and some in England, but the spinning machinery in the best factories has been made in England, and is considered superior to any continental woollen machinery.

Absence of trades' unions.

There are no trades' unions either among masters or men, and in all cases, difficulties between employers and employed are settled without outside dictation or influence. No employer knows what wages his neighbour pays, and the workpeople know very little about the wages paid at the different factories. There is not much migration among the "hands," but it is supposed that the general rate of wages for the same work is fairly uniform throughout the district. About fifteen years ago there was a small strike, but it was not general and lasted only a very short time.

Cloth weaving, &c.

In one of the large weaving establishments we saw the weaving and finishing of cloth made from yarns from Buenos Ayres. The manufacturer informed us that he sends very little of it to England, but that it competes with English cloth in all the markets of the world. Many varieties and colours are made, but there are no designs of so complicated a character as to require the employment of high class artists. There were no figured or floral patterns, but checks, stripes, twills, and combinations of colour without end. From Paris all the new patterns in English and French cloths are regularly obtained, and these are copied or adapted in a cheap form. He did not pretend to make the best goods, but imitations of high class goods in a cheap form.

Care in removing defects.

Judging from the amount of "perching," renovating, and perfecting the pieces after they had left the looms, there was a

strong desire to turn out superior work. In one room in a large factory, we counted 65 women engaged in the above operations, and we heard of many others whom we did not see, who were similarly employed. We calculated that in this factory each dozen looms found employment for a couple of "menders."

Belief in technical schools.

The gentlemen with whom we conversed were very enthusiastic about education as a help to industry. They spoke of the Professional School as having been exceedingly useful in improving the education of the sons of employers, and many of the foremen of works. They have been profoundly impressed by the textile, dyeing, and chemical departments of the school, and their influence upon their staple industry. Not content, however, with the Professional School, which cost 20,000*l.*, and is assisted by an annual grant of 885*l.*, and which has a week day attendance of 348 and on Sundays of 170 students, all free, they have in projection a special school, called l'Ecole Manufacturière, for the promotion of spinning and manufacturing. This school is estimated to cost from 20,000*l.* to 24,000*l.*, towards which the employers have promised 6,000*l.*, the rest to be supplied by the State and municipality. The budget of maintenance submitted to the municipality shows an annual requirement of 1,911*l.* for this school alone, and, coupled with the professional school, of 2,716*l.* a year. The annual budget for the public instruction of 6,748 pupils is 10,900*l.*

Views of the President of the Chamber of Commerce.

The President of the Chamber of Commerce remarked to us that their chief hope in maintaining pre-eminence as spinners and manufacturers, rested on the superiority, not the cheapness, of their productions. They were conscious of their present superiority in woollen spinning, or it would not be possible to send so large a proportion of their products to England. How to maintain their position was the constant study of all the employers in the district. They felt that they could not push cheap production any further. In excellence and good management they were probably unrivalled, but cheap production was as much within the reach of their competitors as of themselves. They believed that educated labour and technical skill, (combined with low wages), were the soundest elements to rely upon in the future, because they promoted excellence, inventiveness, enterprise, and all the qualities required in a progressive industry.

Influence of Professional School.

It appeared to the Commissioners remarkable that a community of woollen spinners and manufacturers, whose industrial success can scarcely be said to have been influenced by education, should be so zealous in their promotion of special instruction in science and art. As to the influence of the Professional School upon the local industries, we are not able to give an opinion. It may be said that the treatment of the burry wool by chemical action, which in the first instance gave almost a monopoly of the use of Buenos Ayres wool to Verviers spinners, was due to the scientific knowledge of the pioneers of the trade. Whether this knowledge was obtained in schools, or was the outcome of practical experience

in works, was not explained to us. Its importance, however, cannot be minimised, for it lies at the root of the industrial development of Verviers; but, except in this one particular, it does not seem that science or art, or general literary culture, has done much for the local industries.

Docile, industrious, and painstaking labourers,—working at a very low rate of wages, unrestricted as to hours, either by factory acts or considerations of health or comfort,—seem, at first sight, to account almost entirely for the cheap production of Verviers yarns. But labour equally cheap may be had in many other towns and countries in Europe, and therefore, however important cheap labour may be, it needs to be allied to other important factors in order to be thoroughly effective.

Character of the Verviers manufacturers.

In this connection we must not overlook the men at the head of the Verviers industries. Speaking generally, they are men of education, who have also been thoroughly trained in all the details of their business. They are intimately acquainted with everything that their rivals in other countries are doing; they buy the best machinery wherever it may be obtained; they seek out markets, however distant, for their productions, and appoint enterprising agents to push their business. They organise their labour so as to make it economical and effective, and study the wants of those to whom they sell.

The effects of the Industrial School.

A Professional School in Verviers, taking into account the industrial conditions of the town, can only reach a handful of the population. But, as was observed to us, if this handful represent the "cream" of the rising generation of employers' sons, or ambitious young workmen who know their deficiencies, and are anxiously seeking for improvement, sacrifices for its promotion are more than justified. The influence of a clever overlooker pervades a whole factory, and improvements such as thoughtful and observant men bring about, are often sufficient to give one firm an advantage over another. It was represented to us that the Verviers spinners feel all this, and promote the school as one of the best agencies by which their several industries may be improved and kept abreast of the times.

Long hours and nightwork in woollen trade.

In conversations as to the influence of long hours and night-and-day-work on the cost of production, conflicting opinions were expressed. The preponderance of opinion was, however, in favour of the economy of the two-shifts system. The matter was explained in this fashion. The fixed expenses, rent, rates, taxes, interest, &c. are the same for 11 hours as for 22. As for extra depreciation, it is an advantage to wear out machinery rapidly, as the employer is thereby enabled to improve it by frequent renewals. It was affirmed by some, that to close the works for 12 hours out of the 24 would be tantamount to closing them altogether, for already the profits are so small that without night work there would be a positive and permanent loss. One of the largest employers, not in Verviers only but in Belgium, informed us that in opposition to the prevailing opinion, he had come to the conclusion that there was no

advantage in night work, and had discontinued it in his factories. No man was more conversant with all the advantages, which, according to him, were more apparent than real, of night work. He had tried the 22 hours system as thoroughly as his competitors, and he had also tried the 11 hours system, with this result, that upon the whole, he preferred working one shift of 11 or 12 hours a day with one set of hands, rather than two shifts with two sets of hands. With two shifts there is always a difficulty about piece work, in fixing the responsibility between the night hand and the day hand, and in weaving, the difficulty is increased. The breakages and faults occur mostly at night; less work is done at night, and the cost of gas is a serious item. Further, our informant added, neither men, women, nor children can keep up their energies in a close, impure, and unchanging atmosphere; fresh air is as requisite for sustaining active life under hard work as good food, and the conditions necessarily accompanying the 22 hours system, tell unfavourably upon the workers and depreciate the value of the work.

Yarn nearly all exported.

As we have already explained, the enormous output of yarn in this busy town is nearly all exported. A large quantity is sent to France and Germany, in spite of the duty and the low price of labour in those countries, but the major portion, fully 65 per cent. of the produce of all the spinning mills, is sent to Great Britain, mainly to Glasgow.

Belgian yarn in Glasgow.

As the "flooding of English markets" by this extensive production of yarn, valued at not less than 1,000,000*l.* annually, has for some time attracted considerable attention, it may not be out of place to give a few facts relating to it, from the standpoint of British spinners and manufacturers. On the visit of the Commissioners to Glasgow in the spring of 1883, several gentlemen thoroughly conversant with the subject were consulted, and a visit was paid to Galashiels with a view of obtaining correct information, and comparing the Scotch and the Belgian yarns and systems of spinning. It was ascertained, that what is known as the "B. A." yarn from Verviers, so largely imported into the Glasgow district, is not made in the Galashiels district, or in Glasgow, or, as far as our informants knew, in England. As before explained, the yarn is made almost entirely from Buenos Ayres wools of the burry type. These "B. A." wools at the present time, are mainly sold in Antwerp and Havre, and English buyers go to Antwerp for them, because they cannot find the same choice in London or Liverpool. Many years ago, when "B. A." wools were first brought to England, they were neglected by English spinners. The "burr" kept them out of use, and no English carders grappled with the difficulty of extracting it. As the wool was grown, so it was exported and offered for sale, and although almost given away, it was shunned by all buyers, while wools of similar quality, but free from the obnoxious "burr," fetched high prices. After a time the wool was experimented upon by the Belgians, who by chemical knowledge, hit upon a process of extracting the "burr;" thus making a yarn very much cheaper for the quality than any offered by

English or Scotch spinners. There was no British yarn like it, and for a time it did not find favour. But its cheapness made an opening for it, and gradually it began to take its place among recognised qualities.

Extraction of the burr.

For extracting the burr, the wool is usually put through a "burring machine" which clears away much of the burr and much of the wool with it. The burry wool is then steeped in a solution of sulphuric acid, which chars the burr, without destroying the wool. The wool thus recovered is either used for inferior spinnings, or is mixed with other wool in small proportions.

Belgians have specially organised mills for burry wool.

Belgian mills and machinery have been organised for dealing with this wool (which is nearly all spun to one count), and although for the last 20 years they have had a monopoly of the trade, and have been able during that time to run their mills night and day, and procure workpeople at wages very much lower than in England and Scotland; yet it was stated to be very doubtful, whether during that time, the Belgian spinners have prospered more than English and Scotch spinners of woollen yarns.

Carding process.

With regard to the machinery employed, it was stated that the carding operations are not the same in Verviers as in Galashiels, and that the machinery employed at *either* place could not *effectively* make the class of yarn of the other. The temptation to make the necessary alterations has never yet been so great as to induce any Galashiels spinners to compete with, and imitate, the "B. A." yarns of Verviers. In reality, the two branches of trade are separate and distinct, and each yarn has its special uses. The Scotch yarns are used for *milled* goods, the Belgian yarns for *unmilled* goods.

Profit of spinning relatively small.

One of our informants had for many years been in the habit of comparing the margin between the price of Buenos Ayres wool and Verviers yarn, and the margin between Australian and Cape wools, and English and Scotch yarn. For some time past he had noticed that the margin between the price of the raw wool and the yarn, was relatively smaller in the case of the Belgian than in the British yarn, and therefore he concluded that the position of the Belgian spinners was relatively *not better* than that of the Scotch spinners.

English competition with Belgium not practicable in "B.A." yarns.

At the same time, our informants held the opinion, based upon frequent visits to Belgian factories, that we in this country could not successfully compete with the Verviers spinners in the production of "B. A." yarns. The lower wages and longer hours of labour gave advantages to their rivals which Galashiels spinners could not expect to overcome. We were informed in Glasgow of spinners who had been moved, by the enormous import of Belgian yarn, to master the Belgian processes, and had made yarns almost the same, but had found the manufacture very unprofitable. They had, therefore, turned their attention to other wools, making a yarn not exactly like the Belgian, but similar. The yarn is more costly, but it is more valuable to the user, and commands a higher price. In some instances it has supplanted Verviers yarn, and its introduction has compelled the

Verviers spinners to lower their prices. Broadly speaking, however, the fact remains that, in the spinning of "B. A." yarns, the position of the Verviers spinners is unassailable.

Use of Verviers yarns in Glasgow.

While upon this question of Belgian yarn, it may not be undesirable to record the opinions, which we quote impartially, of Glasgow merchants and manufacturers, respecting its use in Glasgow. It was stated to us by one gentleman of large experience, and confirmed by others, that the introduction of Verviers yarn had been the salvation of the textile industry of Glasgow.

Rather an advantage than otherwise that manufacture is confined to Verviers.

As to the question of these yarns being made by Glasgow spinners, it was considered to be rather a good thing that they did not make them. There is no organised labour in Glasgow so indifferently paid, as the labour of Verviers. To make these yarns a number of people, who at present earn more than they could get for spinning, would require to neglect the better paid occupations. If the spinners of these yarns in Glasgow were to be paid at the rate of other employment for which they are qualified, unless cheaper methods of production were introduced, the yarns would be dearer than at present, and Glasgow manufactures would have less chance of making a profit by them. Probably the result would be that the Verviers people would turn their attention more to the conversion of their own yarns into cloth, and thus compete more successfully with Glasgow in manufacturing than at present.

Trades become localised for various reasons.

Our informants supported their statements by old illustrations, which may not unfittingly be repeated, to the effect that trades become organised and concentrated in certain localities, often through accidental circumstances. By concentration they secure advantages which it is difficult for new competitors to overcome, even where material conditions may appear to be more favourable. It is in this way that Lancashire is at the head of the world in the cheap production of cotton goods, although wages are higher than in any part of Europe. In the same way Bradford has largely monopolised the mixed worsteds, alpacas, &c.; Nottingham the lace trade, Galashiels and Hawick the tweed trade, and Verviers the "B. A." yarns. The hours and wages in each of these localities are secondary to other conditions which give preeminence to the particular industries.

Worsted Spinning and Manufacturing.—Loth, Belgium.

Visit to worsted manufactory at Loth.

History of works.

Through the courtesy of M. Parmentier, of Brussels, who accompanied us, we visited, on November 18th, 1882, the large and important worsted manufactory of La Société Anonyme de Loth, built and organised more than 20 years ago as a "Belgian Bradford." Machinery from that town was imported, English capital and directing skill were extensively employed, and goods precisely similar to those of Bradford were manufactured. Labour was obtained at a price very much lower than was paid in England,

there were no restrictive Factory Acts or regulations as to the employment of children, the carriage of raw material was less from London to Loth than from London to Bradford; the import duty on English goods acted as a protection, and thus the general economic advantages seemed to be all in favour of the proprietors of this factory. Experience has shown, however, that in the working of the concern, with its many departments, the favourable calculations of its promoters were not all realised, and that against certain advantages there were disadvantages which adversely affected the cost of production.

The fiscal modifications following on the passing of the French treaty became less prohibitive of English goods entering Belgium and other Continental markets, while the increased demand for labour gradually raised its cost, although the wages were always below those of England. It may, therefore, be stated that, in spite of all the attractive conditions which outwardly have favoured these works from the beginning, their prosperity has not largely exceeded that of rival establishments of the same character in England. During the last few years a new department, namely, the spinning of fine yarns on the mule system, has been added to the factories.

We were met at the railway station, which is close to the works, by M. Schafer, the director, who conducted us over the several departments of combing, spinning, weaving, dyeing, and finishing, and freely answered all our inquiries. In this establishment we had the exceptional opportunity of inspecting the French and English systems of worsted spinning, side by side with each other.

Articles manufactured at Loth, Belgium.

The chief products of manufacture are what are known as Italian cloths, merinos, and other wool and mixed fabrics, and worsted yarns for weaving, knitting, and hosiery purposes.

Machinery.

There are 44 combing machines, of which 27 are adapted only for fine short wools. These machines were all made in Alsace on the Heilman principle. There are also 17 combs for medium and long wools, all made in England, nine of which are Lister's "nip combs," and eight Noble's. In the medium and long wools, the preparing machinery is of Yorkshire make, while that for the fine Botany wools is on the "rubbing" system, and made in Alsace. For spinning there are two large factories, the older one containing 10,000 spindles of cap and flyer from Bradford and Keighley; the new mill being fitted with self-acting mules, numbering 15,000 spindles, on the French system, and made in Alsace. A handsome shed contains over 1,000 power looms, most of which have been supplied by a Keighley maker. There are also the buildings and necessary machinery for dyeing and finishing the whole of the production of pieces and yarns manufactured on the premises. The motive power is supplied by three engines; two, of 200 and 250 horse-power respectively, are horizontal; the third, of 800 horse-power, is a magnificent Corliss

valve beam engine, made by Van der Kerchove of Ghent; making a gross total of 1,250 horse-power. Connected with the largest of these engines is a belt, made by a Yorkshire firm, which drives the mill and shed, and is claimed to be the widest in existence, being 72 inches wide.

In the several departments, 1,400 workpeople are employed above the age of 14.

Cottages for workpeople.

The Company are large owners of cottages, which they let at low rentals; 200 are occupied by the ordinary operatives, and about 30, more commodious than the rest, are reserved for managers, overlookers, clerks, &c.

Schools.

There are five schools connected with the works, namely, a kindergarten, a superior school for the children of the more highly paid employés, a mixed school, and two schools for boys and girls, children of the ordinary workpeople.

Chapel.

For the spiritual care of the community there is a priest attached to the factory, who performs religious services in a chapel built by the Company.

Sick club.

There is a sick club and benefit society, towards which a deduction of two per cent. is made from the wages of the operatives. For this consideration, among other advantages, a medical man attends to the sick without fees.

Hours of labour.

As in most of the worsted factories in France and Germany, the operatives here work 12 hours a day, or 72 per week. They begin work at 5.45 a.m. and continue till 7 p.m., with an interval of one hour and a quarter for meals.

There are no Factory Acts and no half-timers. There is no limit to the age at which children can be admitted to the factory, or as to the hours which they may work. We were informed, however, that it is quite exceptional to employ children under 14, and we certainly did not see any that seemed to be below that age. They consider that children, until that age, are too young to be really useful.

Wages.

The wages of carders (girls and women) average from 1*s.* 9*d.* to 2*s.* per day; strippers (men) from 2*s.* 4*d.* to 2*s.* 8*d.*; preparers and finishers (girls and women) 1*s.* 7*d.* to 2*s.*; spinners (throstle and cap) about 1*s.* 7*d.* per day; doffers, &c., a little less. The above, who mind the English machines, are paid by day; the workers in the new mill (mule spinning, &c.) are paid by piece. For a pair of mules the head spinner earns as much as 5*s.* to 5*s.* 6*d.* a day, and is assisted by four helpers (boys) at from 9*d.* to 1*s.* 2*d.* a day each. Weavers earn from 2*s.* to 3*s.* 6*d.* a day by piece.

A few years ago all the heads of departments were English; at the present time there are no English employed on the premises.

Competition with England.

In conversing with the director and other officials, some interesting evidence was obtained as to the relative cost of pro-

duction in the worsted industries in Belgium and in England, with which latter these gentlemen were familiar. It will be remembered that during the depression which a few years ago visited with great severity the long wool industry in England, it was frequently stated that the worsted trade in this country was being ruined by foreign competition; that in consequence of the high wages being paid in Bradford and other towns for 56½ hours' work as against lower wages that were being paid for 72 hours' work of the same kind in other countries, the trade had simply been transferred from England to the competing towns on the Continent. Such statements could not easily be disproved, because, on the one hand, the fact was undisputed that great depression prevailed in certain branches of the wool trade in England, and it was also known that certain wool industries in some districts on the Continent were flourishing.

Causes of depression in the woollen manufacture.

The facts, as elsewhere explained in this report, referred to two branches of the same industry, which are separate and distinct, although known by a common name.

The question of cheaper Continental labour had very little to do with the matter, as may be shown from the experience of this factory, where they have both these branches, namely, those of long and short wools, combining the special features of Bradford on the one hand, and of Roubaix on the other. We were informed that when the depression fell upon the long wool industry at Bradford, it fell with equal severity upon the long wool industry at Loth. In spite of longer hours and lower wages, they were unable to keep their machinery going, and their export of lustre and long wool yarns had to be almost given up. On being asked why certain spinning frames were standing, the director significantly remarked, "It is im- "possible for us to run our machinery at a profit while Bradford "is sick." The opinion was expressed that in spinning on cap and flyer frames, the Belgians cannot successfully compete with Bradford in the neutral markets, even with 12 hours a day against nine and a half. An equally strong opinion was expressed that under existing conditions it is well nigh impossible for Bradford to compete with France and Belgium in mule spinning, because in the wool spinning districts of France and Belgium the operatives have been brought up to mule spinning, just as in Bradford the children are trained to spin at the flyer or cap frame. To be effectively managed, the mule must be minded by men and boys, who are stronger, more suitably clad, and have more "staying power" than women. In France and Belgium the factory competes for labour with the field, and the wages paid to men are not materially higher than those paid to women. In Bradford it is not so. The men work in machine shops, warehouses, dyehouses, &c., and in such works obtain very much higher wages, as a rule, than are paid to ordinary factory operatives. Then, in addition to the question of wages, comes the question of hours, which Bradford must meet under the disadvantage of having the mule system to learn, against

Factories compete with field labour.

trained hands elsewhere, employed at much lower wages than Bradford men are likely to accept.

With regard to weaving, it was stated that the rate paid per 1,000 picks is similar to the rate for the same class of goods in England. One of the officials, of large experience in England and other countries, declared that English weavers get through quite as much work in nine and a half hours as the Loth weavers in 12. Weaving.

In the dyeing department we were introduced to the foreman, a German chemist, who as a youth studied in the Polytechnic at Dresden. He has worked in some of the dyehouses of Bradford and Halifax. He is of opinion that in routine work, with which the men are familiar, the English dyers are as good as any he has seen, but there is a great lack of chemical knowledge even among the foremen and managers of English dyehouses, and thus, even in dealing with new colours and new effects, they are compelled to rely on "rule of thumb" experience, which is often at fault. In this respect they are far behind the Germans. He spoke very favourably of the influence of dyeing schools organised as schools of applied chemistry. He had no faith in schools in which the students are not first taught chemistry, which is the groundwork of dyeing. He is convinced that, with equal advantages in scientific training, the English will fully equal the French and the Germans in the practical application of all dyeing processes. Mr. Schafer acknowledged the value of dyeing schools, within the same limits as any other schools. It had, however, been his misfortune to come in contact with several young men who have attended such schools, whose knowledge has been of no value, because they have not known how to apply it. "There is a tendency in school "teaching to aim at certain ends, without considerations of "economy in the means. A man may dye beautifully, but if "he cannot make the dyeing pay, his knowledge possesses no "commercial value. In this respect the diploma men are often "unsatisfactory." Dyeing. Want of chemical knowledge in England. Value of schools.

In going over these works, and particularly in the weaving shed, we were struck by the clean, tidy, and healthy looks of the workers. In the combing and long-wool departments the women were mostly barefooted, yet fairly clean, and as heathy in looks as in an English factory. Generally the men and women were somewhat stunted in size, and in this respect would not compare with operatives whom we saw in a similar factory in Austria. Appearance of workpeople, Loth.

In spite of the favourable appearance of the workpeople, we were sorry to ascertain that here, as in other parts of Belgium, the drinking of spirits prevails to a large extent. Any person may open a drink shop on payment of a small license, and the increase in the means of obtaining intoxicating liquors has led to their increased use. Throughout our tour in Belgium w Intemperance.

scarcely saw any cases of drunkenness, yet we were frequently informed that among the unskilled workpeople the scale of living is very low, and spirit-drinking prevalent; that there is dense ignorance among the older people, who in past times have been greatly neglected; that the reason why drunkenness is not more common and more visible arises partly from poverty, and partly from the fact that they have no leisure excepting on the Sunday, but that in too many instances the Sunday indulgence unfits them for vigorous and sustained work on the Monday. Education and civilization are so unequal in different parts of Belgium that we found very variable testimony as to the moral and social conditions of the people.

The Works of the Société Cockerill, Seraing.

Visit to the works of the Société Cockerill.

The Commissioners visited the works of the Société Cockerill, at Seraing, near Liége, on November 12, 1882, and, in the absence of M. Sadoine, the general director, we were most courteously received and conducted over the various departments of the works by M. Greiner, director of the steel department. As is well known, the works were founded by John Cockerill, a Lancashire man, in 1817. It is said that in the beginning of his career, Cockerill,—who, besides possessing indomitable energy and perseverance, was a thoroughly skilled workman,—assisted by his son, did all the forging, turning, and fitting of the little shop, the son often having to turn by hand the lathe or drill at which the father worked. At that time the population of Seraing was under 2,000; it is now 50,000, including the adjacent villages. As Cockerill prospered, he purchased the old palace of the Prince-Bishops of Liége, which he transformed into a workshop, eventually roofing over one of the courtyards, which now does duty as an erecting shop. The offices for the clerks and draughtsmen are situated in the original palace, the office of the director forming a part of a large quadrangle, which is ornamented in the centre by an imposing fountain with four bronze figures of brawny artisans. We were informed that the works, including some of the mines, now cover over 250 acres, and give employment to from 9,000 to 10,000 men, to whom 400,000*l.* a year are paid in wages. The company possess 280 stationary engines, with motive-power equal to 12,000 horses, and they consume 1,000 tons of coal and coke per day. In addition to steel rails, which they export to all parts of the world, boiler plates, and other kinds of steel and wrought iron, they are able to produce each year 100 locomotives, 70 stationary and marine engines, 10,000 tons of iron bridges, girders, boilers, &c., and 14 iron ships, besides general machinery, steel guns, hydraulic cranes, and many other kinds of ironwork. Excepting, perhaps, the factory of Le Creuzot, in France, these works are unrivalled throughout the world for the variety of their productions.

For the purpose of making our tour of the works, we were conducted by Mr. Greiner to a handsome tramcar, drawn by a steam engine, which started at the reception room of the offices. We skirted the machine works, ascending by an incline a huge mound of furnace scoria, forming no inconsiderable mountain in this valley of the Meuse, a monument of the labour, capital, and material represented in its production. On approaching the top, we alighted at the collieries, about half-a-mile from the offices. Special car and engine.

The coal shafts are about 2,000 feet deep, the cages being worked by powerful and handsome engines, the whole enclosed by buildings of a permanent and substantial character. In these respects the pits' mouths and banks presented a striking contrast to those of England, where the gearing and ropes in their passage from the engine to the pit head are usually in the open air. The ventilation, as usual in Belgium, is by exhausting fans, and we noted a large barometer in close proximity to the indicating clock, which latter shows the speed of the ventilating engine. The barometer is constantly under the eye of the engineer in charge, and whenever it is depressed, the speed of the ventilating fan is immediately increased, so that the increased development of explosive gas, due to diminished atmospheric pressure, may be as far as possible balanced by increased ventilation. While we stood near to one of these shafts, two of the Government inspectors and the underground manager were brought to the surface. They showed us their safety lamps, and two of the Commissioners had an interesting conversation with them on the relative merits of different forms of safety lamp. Generally these mines have been free from accidents of a serious character, but two years ago there was a terrible explosion, when 62 men were killed. Coal mines.

The coal from one of the shafts was landed and delivered to coke ovens on the same level as the tops of the blast furnaces adjoining, which they supply, thus avoiding, so far as this portion of the coke is concerned, any hand labour except for moving the trucks on the level. The coke ovens were of the Coppée pattern, producing about 75 per cent. of coke from the coal. The labour of dragging and pushing the coal trucks along the viaduct from the top of the shaft to the top of the furnace was performed by women, who seemed robust and healthy. We were informed that the Seraing Company do not employ women underground, and that the rough and exhausting work in which we saw them engaged is voluntarily selected by them. To debar them from it would deprive many strong and able-bodied women from a livelihood, and tend to raise the cost of production by limiting the supply of labourers. Coke ovens.

In the Charleroi district little girls go into the pits and take their share of the rough work with the boys. Many of them continue employment at collieries through life, but female labour is becoming less and less common. Although there is no Women employed in mines at Charleroi.

law against the employment of females underground, the public sentiment of the country has risen against it in the Liége basin. They are, however, commonly employed on the banks screening, dressing, washing, and moving the coal.

School for miners, Seraing.

There is an evening school for miners connected with the works, which is attended by about 130 boys, all of whom, in addition to elementary subjects, are taught the elementary principles of mining and the nature of the gases which so constantly imperil the lives of the pitmen. Three large firms have started similar schools, and, so convinced are the rest of the colliery proprietors of their importance, that schools of the same character are being established in all the coal districts.

Wages.

The wages of miners are paid by the ton, and they earn on an average about 3*s.* per day; banksmen earn about 2*s.* 6*d.* per day; women on the banks at tramwork, &c. earn about 1*s.* 8*d.* per day.

The miners and the men and women on the banks, work in two shifts of eight hours a day each.

Near the mines are almshouses and an orphanage for widows and children of miners who have been killed or disabled at their work. The institutions are maintained by the subscriptions of the miners and by large subsidies from the company.

Blast furnaces.

From the pit head we were taken in the steam tramcar up a further incline to the summit of the huge mound of scoriæ, where we found ourselves on a level with the tops of a set of four new blast furnaces. The ore which was being smelted is imported from Bilbao, in Spain. The trucks from the railway, without being unloaded, are brought by locomotives to the top of the mound, where the contents are ready for being discharged with the greatest ease and economy of labour, directly into the furnaces. We descended by an iron staircase to the foot of the latter, where some of the iron was being run into moulds for pigs, and the remainder conveyed in a molten state to the Bessemer converters for steel making. The spectroscope is employed with great advantage in indicating the precise moment when the conversion is so far completed that the metal is ready for the addition of the Spiegel, thus dispensing with the ordinary practice of arresting the blowing while "proofs" are being taken. All the work in this department was being carried on with precision and order, and the arrangements of the casting pits were very practical and complete.

Men paid by weight of steel made.

The men work in gangs, and are paid by weight, according to scale, each in accordance with the importance and difficulty of his work. Heaters earn about 5*s.* 6*d.*; rollers, 6*s.* per day; blowers and pourers of the metal average about 4*s.*; the labourers who assist, and remove the ingots, are paid about 2*s.* 6*d.* per day. The activity of the groups of men clustered at this point may be inferred from the fact that they make and

pass forward to the next department upwards of 350 tons of steel per day.

Foundry

The foundry is very large, well lighted and ventilated. A remarkable feature in the foundry was the excellence of the very large and complicated loam castings. In this department we were informed that the wages are from 4*s.* 6*d.* to 5*s.* for the men, and from 9*d.* to 1*s.* per day for the boys.

Mechanical workshop.

The fitting and turning shop, and the engine-erecting shop are of corresponding proportions to the other branches of the works, and it may be sufficient to say of them that they are arranged with a view to economy and efficiency, and that nothing seemed to be wanting in the way of tools and applicances for doing work on a large scale, and doing it well. Great cleanliness pervades the whole works. We were informed that the director complains if a paving-stone be out of its place. He will walk over the works observing everything, and if a pane of glass is broken, or a few drops of oil are running from the neck of a shaft, and dropping on to the floor, the responsible person is reminded of these things. In the steel department alone they spend 120*l.* a year on besoms.

The mechanics, all of whom are paid by piece, earn as follows: boiler makers, about 3*s.* 3*d.* per day; fitters, 2*s.* 9*d.* to 3*s.*; smiths, 2*s.* 3*d.* to 3*s.* 6*d.*; labourers, 2*s.* 6*d.*

Draughtsmen.

The drawing office of an establishment turning out so much original, varied, and complicated work, is necessarily a department of importance. Upwards of 100 draughtsmen are employed, of whom the head is an Austrian, who received the theoretical training of an engineer in the Polytechnic School at Vienna. At least 25 of the draughtsmen are Germans, Swiss, and Austrians, who have gone through Polytechnic or other technical schools. The rest are nearly all Belgians, some of whom have attended the University at Liége. One of the managers stated that when he was a boy, the leading engineers in iron and machine works everywhere on the continent were Englishmen. They were engaged at high salaries because of their practical knowledge of work and workshop requirements, and it had been a custom to select them from the works of rival English firms of eminence, so that they might learn the secrets of English skill, and copy English methods. Since that time they have found that the English, though practical, are not scientific; they bring with them no advantages to compensate for the high salaries they require, and they are now seldom engaged. Although at one time several Englishmen held leading positions in these works, beginning with the founder, he was not aware that a single Englishman is at present employed in the entire works.

Competition of England.

The company do not sell much of their produce in England, but elsewhere in all tenders for machinery, engines, or raw iron and steel, their chief competitor is England. In everything they

make, they take England as their guide and as their rival, and they are compelled to fix corresponding prices on all their products. They buy from England every tool that tends to cheapen production, and they watch the progress of English inventions and appliances as if England were situated across the river.

Principles of management, Seraing.

We were informed that although all the departments of these vast works are connected with each other under one head, they are commercially distinct. The colliery manager sells his coal at the best price he can get for it. If the smelters and steam users of the establishment will not give as much for it as outsiders, he passes them over and sells to outsiders. In the same way, if these coal users can buy cheaper and better coal outside, they do so, and compel their own coal manager to work "close to the nail." This method keeps all the departments up to the mark, and prevents them, in times of depression, from blaming each other for want of success. They all clearly understand, however, that the interests of the shareholders are best promoted by the harmonious working of all the departments, and this is secured by the supervision of the general director.

Apprentices.

During our tour of the works we had interesting conversations with Mr. Greiner and others respecting the training of apprentices, the division of labour, the education and general condition of the operatives, and other questions relating to this inquiry.

As in the other great works visited in continental countries, boys are not admitted to the works under 14 years of age, and they are not bound for any period, or for any definite employment, or salary. There is no fixed age, when a boy finishes his so-called apprenticeship and becomes a journeyman. When a boy comes to the works he is put to some simple occupation, and paid by piece. The question of passing a boy forward is settled in accordance with the simple principles on which the works are conducted. They endeavour in everything to secure the best possible results by the most economical and efficient means. The dull boy is put to routine work, and kept at it; the intelligent, quick boy, is put to the work that requires brain-power and skill. In both cases their plan is mutually satisfactory.

Division of labour.

Division of labour is universal. Many men learn to do one thing and no other. It would not be to their interest to take a boy or a man from a machine, or from some kind of work which he manages well, and to put him to another kind of work which he would have to learn. Time and money would be lost during the process of learning, and neither master nor workman is prepared for the sacrifice. Almost universally a man prefers the work at which he can earn most money; call it a trade or only the tenth part of a trade, it is all the same to him, and any change of employment that would lower his wages, would certainly cause him to complain. Thus the apprenticeship system of former days no longer exists, and the division of labour, whatever may be its effect upon the general capacity of in-

dividual men, is pushed to quite as great an extreme here as in the large workshops in England.

Mental training.

On the question of the scientific and technical instruction of young men, there were no two opinions among all those with whom we conversed. The managers of all the departments consider that next to the best possible tools and appliances for their work, the most important factor is the technical knowledge of their men. In order to promote this knowledge they take great interest in the schools. Attendance at night schools is not compulsory, and they complained that many youths were apathetic and lacking in desire for improvement, but there was an undoubted superiority on the part of those who applied themselves to theoretical studies. When asked whether the naturally intelligent and studious youths would not surpass the dullards, even without attendance at night schools, the reply was that night schools were especially useful in developing and cultivating the natural faculties of the more intelligent young men. It was argued that dull apprentices were improved by education, but that intelligent apprentices were doubly improved by it, and that therefore, looking at the question from the point of view of the employers, it was more important to educate the quick boys than the dull ones.

School for miners.

We have already alluded to the school for miners, attended by 130 boys. There is also an industrial school, resembling the school at Liége, in which there are 100 students in the preparatory section, and 270 in the industrial school proper.

Adult night schools.

In addition to the technical and special schools, there are adult night schools connected with the works and the town of Seraing, which are attended by from 1,800 to 2,000 students, varying from boys to middle-aged men. Whatever disappointment there may be that the educational provision is not taken advantage of as it ought to be, these numbers indicate a considerable desire for instruction among the men, and reflect credit on the heads of the departments who encourage the young men under them to attend the night schools. Mr. Greiner strongly urges all young men in his department (steel) to attend such evening classes as are suited to their abilities and requirements. A monthly list of attendances is submitted to him, and in cases of absence he demands to know the reason why. In instances of wilful neglect of instruction, and repeated absence, without cause, he has dismissed young men from his employment altogether. Happily, in requiring the attendance of apprentices, he has the co-operation of parents. The night schools are free.

Danger of a little learning.

It was stated, that in pushing education indiscriminately amongst young men, there is a danger to be guarded against. Many who find that they know a little more than their companions, become conceited and spoiled. They have an impression, that because they know something of mathematics and

algebra, and can draw a machine, that therefore they ought to have their wages advanced or be promoted to foremen. This feeling becomes less prevalent year by year, because the higher attainments among the young men are becoming more common. Time and experience correct the ambitious fancies of many of these young men, and the young fellows who get promotion, or take higher situations elsewhere, are those who excel in the class rooms as well as in the workshop.

Societies for recreation, Seraing.

There are several societies established by the employers, for the purpose of promoting good fellowship and amusement. Amongst these are musical societies with brass bands, and orchestral bands of stringed and reed instruments. The workmen join in these entertainments. They have, every winter, weekly lectures in the largest room in the town, given by the heads of departments in the works, by scientific and literary men from the University of Liége, and by popular lecturers from different parts of Belgium.

Lecture on electricity.

Mr. Greiner was advertised to give a lecture in the following week on the "Industrial Applications of Electricity," and he felt confident that he would have a large and appreciative audience, composed chiefly of workmen. Twenty-four lectures were to be given during the winter (1882–3). Musical and literary entertainments, analogous to the penny readings so popular in some parts of England at one time, have also been introduced. The music and readings are supplied by the workmen, and the meetings are often presided over by the departmental directors, or by leading residents unconnected with the works. There are also gymnastic clubs, and athletic competitions are periodically held.

Trades' unions.

There are no Trades' Unions, and we did not hear of any organised methods for the settlement of disputes. Since 1838 there has been a sick club, to which all the workmen contribute. Until about ten years ago, the club was managed by the Company in the interest of the men, but the system was abused, for workmen frequently claimed the benefits of the society on pretences, whose groundlessness could not always be disproved. A committee of workmen now manages the society, and investigates all applications for relief.

Co-operative stores.

Connected with the works are large and important co-operative stores, managed by the members of the society, in the same way as in England. Food, clothing, fuel, and other necessaries of life, are sold at as near the cost price as possible, and the stores are largely patronised.

Sobriety.

There was general unanimity among the gentlemen from whom we inquired, as to the sobriety of the workmen. Not one of them had any serious fault to find with the men on the score of drunkenness; in fact, it is so rare as almost to be unknown as a cause of time being lost. When asked if many

men absented themselves through drink, after a holiday, the manager of one of the largest departments answered by an emphatic "No."

Lodgings.

We were informed that many of the workmen reside 10 or 15 miles away from the works, and come for the week, bringing their food with them. This consists of two large loaves, a piece of bacon, or sausages, and eggs; they buy potatoes, onions, &c. They get lodgings for 2*d.* a night. This kind of life is quite common; small things satisfy these country people, and they save every possible farthing of their earnings. Their families in the meantime cultivate their little plots of land at home, which in many instances have been owned by the same families for generations. The workmen from the country with simple tastes, and habits of thrift, are considered more trustworthy than natives of the town, some of whom are apt to go off by the tram cars to Liége, at night, to amuse themselves.

Crèches.

Crèches are institutions, which are common in the manufacturing districts of France and Belgium, and are also found at Seraing. They are nurseries for young children, generally managed by "sisters," who tend and feed the children for a nominal sum while the mothers are at work. The children are taken at a very early age, in fact often as soon as their mothers are able to work after their confinement. In many instances a mother will leave her babe at a crèche as early as five o'clock in the morning. It will be taken from her arms by one of the sisters, and the mother will call for it again on her way home from work in the evening. The crèches are furnished with cradles, small beds, and cots on the floor, to suit the needs of the children. The little ones are carefully washed and fed, and the nursing rooms which we saw were scrupulously clean, and comfortably warm.

Vieille Montagne Zinc Works.

Visit to the Vieille Montagne zinc works.

These extensive works, the largest zinc works in the world, cannot be omitted in any description of the metallurgical and manufacturing industries of Belgium. They are situated at Chênée, a village near to the Cockerill works at Seraing, near also to the glass works of Val. S. Lambert, and employ 1,800 hands. The industrial importance of the district may be appreciated when we state that for the amount of space covered, the capital invested, and the number of workpeople employed, there are probably no three works on the Continent, varying in character, but contiguous to each other, that compare with these vast establishments in the valley of the Meuse.

Number of workpeople.

The total number of workpeople employed by the Vieille Montagne company is 7,500, who are distributed over 18 mines and smelting works in France, Germany, Algeria, Spain, Sardinia,

and Sweden. Their mines annually supply them with 70,000 tons of minerals of various kinds, besides which they purchase large quantities. The total indicated horse-power of their engines is 5,000.

Processes of manufacture.

At the central works at Chênée the processes of smelting the ore, and rolling and manufacturing the zinc plates are carried on, and 750 men are employed. The grinding and mixing of the clay, and the moulding of the crucibles in which the zinc ore is smelted, are among the most important operations performed in the works; the clay is mixed, pugged, and moulded into crucibles by self-acting machinery. As an example of the saving of manual labour caused by the use of improved machinery, we were informed that three men and three boys now attend on one machine, which, in a day of 10 hours, makes 110 crucibles, of 4 feet 6 inches in length, by about 8 inches in diameter, to produce which 40 men at much higher wages were formerly required.

Age of work-people admitted.

There are no children employed, and boys are not admitted until they are 14 years of age.

Hours of labour, Chênée.

The hours of labour vary in the different departments; men engaged in the ordinary mechanical branches work 10 hours a day. The furnaces are kept constantly going, and most of the men in this department work in shifts of 12 hours each. The "overmen," who are actually responsible for the working of the furnaces, work in shifts of 24 hours.

These latter are paid jointly by day and by tonnage. Half the excess of tonnage over day wages is retained, and only paid at the end of six months, if the men remain to the end of that time; the excess over day wages being considered a bonus, a portion of which may be kept back in case of an earlier termination of service. The ordinary payment is fortnightly. Zinc rollers earn about 4*s.* a day of 10 hours, and this branch of work goes on night and day. Makers of "Lozenges" (for roofing tiles) earn from 3*s.* 3*d.* to 4*s.* per day.

Zinc products.

An enormous trade is done in sheet zinc, rolled to suit the requirements of customers as to size and thickness. They also have a very large sale of tiles, beads, and guttering for roofs of churches and houses. These are made of many shapes, and on the benches in the workshops they have numerous models of roofs of churches and domestic buildings, showing on a small scale the shapes of the tiles required for different purposes. The patterns of ornamental articles of every conceivable kind to which zinc can be applied, are distributed in books by the company.

Zinc products of Belgium and other countries.

To show the relative importance of these works, compared with those of other countries, the Director, M. Saint Paul de Sinçay

informed us that the zinc products of the world amount to 236,000 tons annually. These are supplied as follows:—

	Tons.
Vieille Montagne - -	50,000
Other works in Belgium -	24,000
Silesia - - - -	70,000
Three or four works, Rhine -	36,000
England - - -	25,000
France - - - -	12,000
Spain - - - -	4,000
United States - - -	15,000
	236,000 Tons.

The Vieille Montagne Company export about—

Tons.	
10,000	annually to England.
20,000	„ France.
10,000	„ Germany.

The rest of their product is used mainly in Belgium.

England distanced in zinc works.

It is very remarkable that this industry, which flourishes in Belgium and Silesia, should be comparatively neglected in England, considering the advantages which we possess in the cheap transport of ores from various parts of the world. It is a remarkable fact that the zinc products of Belgium are three times greater than those of England, and that the Vieille Montagne Company alone export to this country 10,000 tons, while our own total production is only 25,000 tons. It has been said that in the reduction of the ores in the crucibles, a most delicate operation, the Belgians and Germans have acquired greater skill than has hitherto been shown by Englishmen, and that although foreign workmen have been introduced into England, the result has not been attended with success. Undoubtedly the palm in this important industry is borne by foreign producers. It does not appear that the greater success of our neighbours in this manufacture is due to technical instruction in schools.

Clerks.

The company employ 200 clerks, but there is not one Englishman among them. The chief clerks, and particularly those who conduct their English correspondence, are Germans and Swiss.

Swiss chemist.

The chief chemist in the laboratory, &c. is a Swiss.

Statements of the director on education.

The director is a great believer in education. He requires all the boys, who are admitted to the works at 14, to attend an evening school, and also classes either in vocal or instrumental music. At their other establishments they have schools in connection with the works, but here their young men in the advanced subjects attend the evening classes in the town of

Liége. M. de Sinçay considers that intelligence is of the highest importance in every department of the works. He does not lay down any hard and fast line as to the studies that his workmen shall engage in. "I am not prepared to say," he remarked, "that attendance at the night schools makes the youths more "skilled workmen, but it trains them to habits of thought and "reflection; it keeps them from worse places, and tends to make "them better men."

The ordinary workmen have not received any special education qualifying them for the posts which they occupy. From 12 to 15 of the men attend the School of Mines, and a number of them attend the evening classes of the University and School of Art at Liége. The director assured us that mathematics and mechanical science are admirably taught at Liége.

Conversations with M. Paul Trasenter and M. de Sinçay.

While making the tour of the works, we had an interesting conversation with M. Trasenster, son of the eminent Rector of the University of Liége, and consulting engineer of these works, and M. de Sinçay, junior, (son of the director) recently a student in the technical department of the University of Liége. These gentlemen informed us that the students from the University visit these works frequently, and also all the other important engineering, mining, and manufacturing works in the neighbourhood of Liége. The proprietors and directors of the works are not in the least afraid that the students may run off with their secrets. They are all anxious to promote, as far as they can, the progress in scientific knowledge of the younger men, to whose hands the future development of these industries will be entrusted. As for secrets, they do not, as a rule, possess any. Good machinery and good management are the conditions relied upon for success.

Engineering Works of Van der Kerchove, Ghent.

Visit to engineering works at Ghent.

Among the purely engineering works visited by the Commissioners, those of Van der Kerchove, at Ghent, were among the most important, although not by any means the largest.

This firm is one of the licensees for Corliss's patent steam engines, and we were desirous of seeing the works, in consequence of having been greatly impressed by several engines made by this firm, which had been shown to us in Belgium and other countries. The magnificent engines at the great flax mills in Ghent were constructed here. They are beam engines, indicating 2,000 horse-power, with Corliss's "cut-off" valve, and resemble the engines made by the same firm and shown at the Philadelphia Exhibition in 1876, where they excited very marked attention.

Hours.

We were informed that the working hours are 10½ per day, and that, contrary to the custom of most of the industrial establishments which we have visited abroad, the wages are paid mainly by day. Comparatively few of the men are paid by

piece, and the day system is adopted advisedly, as being more conducive to the production of first-class work than any other. On being asked for reasons for a method of payment so unusual on the continent, the director stated that where men were honest and faithful, the system of day-work was unquestionably best, for then there was no temptation on their part to scamp their work, and throughout the shop, the maxim was, quality, rather than quantity. Besides, the work was so often changing, that it was exceedingly difficult to assess its value.

Trustworthy men only engaged.

The director stated that they took great pains to engage trustworthy men; they trained their young men to take a pride in their work, and to this they attributed the high standard of excellence attained by their productions.

Pay of men.

The ordinary mechanics are paid, on an average, about 3*s*. 6*d*. a day. Younger and less skilled menreceive 2*s*. 6*d*. To their first-class men, of whom they employ a considerable number, as much as 4*s*. 9*d*. per day is paid.

Draughtsmen.

Eight draughtsmen are employed at these works, of whom the chief is an Englishman; some are Germans and some are Swiss, and most of them have attended the University or Polytechnic School.

English machine tools.

In going over the shops, we found them admirably furnished with large and small machine tools, for doing with precision the heaviest as well as the most delicate work. The large tools were almost exclusively English, and from the most celebrated makers. Some of the smaller tools, especially "milling" tools, were of American manufacture. There are very few engineering works at home or abroad, where the different parts are to so great an extent finished ready for erection, by specially adapted machine tools. The engines made are mostly for textile factories, but more recently for rolling mills.

English manager.

Mr. K., the works manager, is an Englishman, and it is rather remarkable, that he was the only Englishman in an important position that we met with in any of the works in Belgium. He stated to us that the former shop manager here was an Englishmen, now dead, and that he had greatly contributed by his sound and practical methods, to the thoroughness which at present characterised the work of every department of the establishment. He was still often held up as an example. Mr. K. said that a few years ago, Englishmen were frequently found in leading positions in most of the mechanical and manufacturing establishments. The proprietors in the meantime had trained native foremen, and, as the places fell vacant, they were filled by Belgians and Germans, who were frequently more competent than Englishmen, being more highly educated, and having in many instances worked in the most advanced shops in England. His experience has shown that during recent years it has been much more difficult to fill a situation as manager or principal draughtsman on the continent than in

England. Engineering has been made as important a subject for the class-room as for the workshop, and the more showy theoretical engineers have appeared to advantage, compared with uncultured Englishmen, because they were better draughtsmen and have had more to say for themselves. Mr. K. left school at 14 in London, and went through his apprenticeship as a practical workman at Messrs. Simpson's, the celebrated waterworks engineers. He studied French, and afterwards, before coming to Belgium, took a situation at Messrs. Gouin's works at Nantes. He would never have been able to hold his own against the rival engineers that he has met, had it not been for hard study out of work hours. Hundreds of times has he got up at three or four in the morning, to master certain calculations before beginning the work of the day. Had it not been for this determination, and possibly for inherent mechanical faculty, he would have been pushed aside years ago. He has several University men under him, much younger than himself, and he owns that his one advantage over them is practical knowledge. The weak point in the training of foreign managers is that they get too little practice in the shop. They go to the University or the Polytechnic, and usually remain there till they are upwards of 20. It is impossible for them at that age, and without experience in real work, to compete with practical men, in the internal economy of the workshop.

Training of manager of engineering works, Ghent.

Continental training too theoretical.

The continental system tends rather to a separation between the practical and the theoretical branches, for, as a rule, the two necessary factors of an engineer are not found in one person.

Ideal training.

In the same way the English system, having left theoretical instruction to chance, tends to the development of the practical and to the neglect of theory. Mr. K's. ideal of the education for an engineer is that the boy should get a good general education at school, go to work early, say at 14 or 15, and continue his theoretical instruction at night. In England his opportunities for this are very much better than in Belgium, although even here, with 10½ hours work per day, he has more leisure than the workers in most of the other industries, whose hours are generally 12 per day. Like Mr. A., the English manager in Bavaria (page 337), Mr. K. is a great believer in education, and is of opinion that if English workmen would train their intelligence, in addition to their hands, they would surpass all others.

Capacity for works.

He thinks that good English workmen can do 20 per cent. more work in the same time than either Frenchmen or Germans. The English are more energetic and keep up the pace better; they have greater strength than their continental rivals. The English atmosphere, take it all the year round, is more bracing for the workman than that of the continent. Mechanical industries in England are usually more concentrated; English workmen have been brought up on a more liberal allowance

of animal food than any of their continental rivals. The Belgians, however, are rapidly improving in stamina. The advances in wages during recent years have raised the standard of living, and in this important respect the difference between the Belgians and the English is lessening. Labour has been better paid, but the cost of production has certainly not increased, because more work has been done, and were wages to rise still higher, the cost of production would probably remain much the same as at present.

Drinking habits of English workmen.

It may be a good thing industrially that British workmen eat more than their rivals, but it is a great misfortune that many of them drink more, thus wasting time, earnings, and strength, and wilfully throwing away some of their chief advantages.

In comparing with those of England such works as the above, in which the best English labour-saving appliances are fully utilised, and work of the highest class is produced, the formidable character of foreign competition becomes apparent. We found instances in different industries, which showed that the foreign competition which presses us most seriously is more frequently that in which the conditions as to hours and wages approach nearest to our own, rather than, as might be expected at first-sight, where the hours of our competitors are longest and their wages the lowest.

Woollen Spinning and Weaving.—Biella, Italy.

Woollen mill at Biella.

In the mountainous district, of which Biella is the centre, there are several factories for the weaving and dyeing of cotton, and for the manufacture of woollen goods. There is but little cotton spinning in the immediate neighbourhood, but there are spinning factories in other parts of the north of Italy, and the competition for the sale of yarns to the local manufacturers is between Italy, Switzerland, and England. English yarns come by sea to Genoa, and thence to Biella by rail. The Swiss yarns were entering Italy by the Simplon and St. Gothard Passes, and were carted all the way from the Swiss factories. The same import duties were being levied on English and Swiss yarns, but the latter were receiving the greater attention by the manufacturers. Several factories are situated in the picturesque valley of the Servo, and are run by water-power from the river. Biella, a town of 15,000 inhabitants, is flatteringly described by some of its inhabitants as "the Manchester of Italy."

Signor Sella's factory.

The Commissioners paid a hurried visit to the woollen factories of the late distinguished statesman Signor Sella, who was also a large manufacturer. Signor Sella and his family connections have long taken a deep interest in everything that concerns the welfare of the town and the improvement of their work-

people. The free library of 10,000 volumes was the gift of Signora Sella, and the professional school, which is acknowledged to be one of the most useful in the country, owes its success in a great measure to the warm interest and assistance of the family.

320 hands employed in woollen factory, Biella.

At the woollen factory 320 hands are employed, and we were informed that so extensively is modern machinery in use, and labour-saving appliances adopted, that it might be said with confidence that nowhere in Italy is better and cheaper work done for the number of operatives employed, while at the same time there are no woollen operatives in Italy in receipt of higher wages.

Hours of work.

The hours of labour are 12½ per day in summer and 11½ in winter; beginning in the summer at 5 o'clock in the morning and continuing till 7 in the evening, with one and a half hours for meals; and in the winter beginning at 7 o'clock and continuing till 8 in the evening, with one and a half hours intermission.

Wages.

There being no Factory Acts, children begin to work at eight years of age, and from eight to ten are paid from 4*d.* to 7*d.* per day; card-feeders, women, 1*s.* per day; dyers, 1*s.* 6*d.*; weavers (by piece) from 9*d.* to 1*s.* 6*d.* per day; overlookers from 2*s.* 3*d.* to 3*s.* 3*d.* per day; a self-acting mule minder (by weight) makes from 2*s.* 6*d.* to 4*s.* 6*d.* per day, and is assisted by a number of boys, to whom he pays from 5*d.* to 8*d.* per day each.

English machines.

English machinery was generally employed throughout the works, and all the processes, from the sorting of the wool to the dyeing, finishing, and making up of the pieces, were being efficiently conducted in the establishment. An enormous variety of goods is made; from common flannels to tweeds and worsted coatings. The head designer is a Frenchman, and many of the patterns and combinations were very attractive.

Designer a Frenchman.

Foreign competition.

With regard to foreign competition, although protected by a considerable import duty, they are closely pressed, even in the Italian markets. In fine goods the competition with France is severe, and in low goods they have equal difficulty with England. Even with labour at the prices above quoted, with long hours, and cheap water-power, they do not dream of the possibility of competing with England in neutral markets.

Savings Bank.

Signor Sella adopted many means of promoting thrift among his workpeople. A branch of the Post Office Savings Bank is open on the premises, and to any of the workpeople disposed to open a banking account, the firm present a bank-book and a "nest egg" of one franc. Several prizes are also given to those who make regular monthly deposits. One prize indicates the passion among Italians of all ages for games of chance, &c. To those under 18 years of age, who deposit in the Savings Bank one franc per month, a lottery ticket is given with a chance of the possessor winning a prize of 100 francs.

There is no organization in the works for education, although the firm are the chief promoters of the Professional School. It is impossible, in works which run till 8 o'clock at night, for the operatives to attend evening classes after work hours, but many attend the Technical School on the Sunday. Special arrangements are, however, made in favour of six youths, who are sent to the evening classes to study engineering. Education of operatives.

Three years ago, in this small town, there was enacted one of those struggles—happily matters of history now, in England—which among the uneducated and ill-fed classes in different parts of Europe still greatly retard their prosperity. Signor Sella was anxious to improve his manufactures by changing from hand-looms to power-looms. This necessary alteration had long been postponed in consequence of the dread of revolt and the determined opposition of the workpeople. The step was at last made, and power-looms were imported and erected in the factory. A strike took place, and for six months a large detachment of soldiers guarded the premises day and night, to protect them from incendiaries; 60 soldiers accompanied 30 weavers to and from their homes night and morning, in order to save them from the violence of the strikers. In every instance, we were told, the change had materially benefited those who had most strenuously opposed it. Resistance to introduction of power-looms

We were interested in an experiment made by Signor Sella in the formation of a number of model cottages from the rooms of a disused mill. The several flats were entered from a staircase at one end of the building, and railed balconies had been erected on each storey, giving access from the outside to each tenement. Some of the dwellings contained a living room and bedroom; others a living room and two bedrooms. In some there were small cooking-stoves, with room for one or two pans, but in many of the rooms there was simply an open hearth, with three or four loose bricks for confining the handful of fire when cooking operations are required, or artificial warmth is indulged in. In one dwelling of two rooms, a little girl of four or five years of age was nestling close to a small fire of sticks, and tending a cooking pan that was over the fire. The mother was busily occupied in arranging the room. We were taken into the bedroom, and our attendant, the woman who acted as caretaker of the block, pointed, with some enthusiasm, to a baby wrapped in swaddling clothes on the bed. She told us that it was but three days old, and that the busy housewife, whom we had seen at work in the next room, was its mother. Workmen's dwellings.

Silk Factory for Reeling, Throwing, &c. —North of Italy.

The conditions of factory labour connected with the reeling of silk from the cocoon and preparing it for manufacturing, are among the most remarkable that we became acquainted with Italian silk industry.

during our tours of inspection. As is generally known, the processes connected with the silk culture, the feeding of the silk-worms, the hatching of the eggs, the production of the cocoons, &c., are extensively carried on in farms and cottages in the North of Italy. Mr. Kelly, Her Majesty's Vice-Consul at Milan, who has given some attention to the subject, explained to us the details of this important cottage industry, and the steps taken, in consequence of the researches of M. Pasteur on the detection of the diseases of silk-worms, for applying his recommendations founded thereon.

Italian reeling and throwing factories closed in summer.

During the summer months the reeling and throwing factories are usually closed, and the girls who find employment in them are busily engaged at their own homes and at the many farms, in rearing and feeding the silk-worms, superintending the hatching of the eggs and the production of the cocoons. They also work in the fields, harvesting the corn, maize, and fruit for the winter food of the people. Thus from May until September the girls and young women live mainly in the open air, but when out-door occupations no longer demand their attention, and the cocoons have been collected, classified, and sent to the factories, a great change takes place in their employment. They migrate to certain centres for attendance at the factory, and during the next eight months they are occupied in reeling, throwing, and preparing the silk for the purposes of manufacture in the form of yarn. During our visit to the north of Italy, we had the privilege of inspecting one of these factories. We were admitted through what in England would be called a "time office," the only entrance, into a quadrangle, surrounded by the different departments of the factory. It was 6 o'clock in the evening (in November), and the rooms were lighted up. The motive power was supplied by a small steam engine, and the mechanical arrangements generally were evidently not of recent date. We were informed that 250 females find employment in the works.

Silk reeling from cocoons.

Having mounted a dingy staircase of three storeys, we entered a large room, crowded with machinery for the operations of silk reeling from the cocoon. In this room there were upwards of 150 girls and children working at the first process called "tracture." Along the sides of the room were benches, and small pans of water in sets of four, heated by steam to a high temperature, and superintended by children, who were required to agitate the cocoons in the hot water, so as to soften the gummy fibres. The children stood to their work, barefooted, on the wet tiled floor, and ran backwards and forwards to the reelers, conveying to them, in perforated ladles, the prepared cocoons. The machines for winding were ranged across the room, and the reelers sat in rows, each facing a pan of hot water, in which the cocoons floated. In commencing the process of reeling, the outward covering at the end of the cocoon has to be dexterously removed, until the fibre will unwind freely. The reeler thus prepares five cocoons, the

ends of which are united and carried through a "guide wire" to a mechanical reel upon which the silk is wound. The cocoons dance on end in the water, the reeling being conducted with comparatively few breakages. It can easily be seen when a fibre has broken, by the floating away of the cocoon, but without any stoppage in such cases, the girl is able quickly to find the broken end—as she would find the end of a cop of fine cotton—and rapidly throwing the gummy fibre into contact with the running ones, she is able to keep up the five-fold operation. Each girl had by her side a weighed quantity of cocoons which she was expected to reel in the course of the day. The system can hardly be called piece-work, but the effect of the strict control exercised, answers the same purpose. The waste is taken into account as well as the reeled silk, and when more than the specified quantity is reeled, a slight bonus is given, but, if habitually less work is done than ought to be accomplished, "well," remarked our conductor with a significant shrug, "she does not stay long."

Abundance of labour.

Hands are plentiful, and, we were told, are fond of the work. Children begin to work at eight years of age, so as to acquire early the necessary dexterity, and they work on through the day with their elders. As may be imagined, with steam and hot water everywhere, under the faces of the workers—the floor being also constantly wet with hot water—the room was exceedingly hot, and the atmosphere full of steam and moisture. The temperature, we were told, is seldom lower than 80 degrees, often higher; and the smell from the semi-boiled cocoons was, to say the least, offensive.

Appearance of operatives.

The appearance of the operatives impressed us favourably. The children, although so young as eight in some instances, seemed to be healthy, active, and cheerful. The elder girls and women who sat at their work, although barefooted and lightly clad, were invariably clean and tidy in appearance. Their thick black hair was in most cases plaited and arranged in folds at the back of their heads, being fastened by circular combs, in many instances remarkable for size and decoration. Not a few were adorned with large ear-rings, and their print dresses of variegated patterns gave a picturesque appearance to the wearers, not often found among factory operatives. In general appearance the women seemed to be equal in healthiness and physique to the better specimens of the ordinary peasant women seen in the north of Italy. As an evidence of their contentment, they were singing cheerfully as we entered the room, and although, on seeing such an invasion of strangers, they subsided into comparative silence and gossip, yet on a hint being given that we were pleased with their music, and would like it to be continued, their voices gradually found vent again, and even some time after, as we left the establishment, we could hear the distant refrain. It may be partiality, but we did not think that their voices equalled, in sweetness and purity of tone, the singing of factory girls in Yorkshire.

Wages of reelers and throwsters, North Italy.

As to their wages, we were told that the most highly paid receive about 1*s.* 2*d.* a day, and that 5*d.* a day is considered good pay for the children. It was only, however, as we inquired point by point, and were led from one department to another of the factory, that the conditions of work and wages, and the daily life of these 250 operatives, were gradually unfolded to us. On our remarking that the wages seemed to be somewhat low, our conductor informed us that the money payment by no means represents the substantial advantages which the operatives receive. Every day at noon, a large basin of soup and bread is served to each of the hands; the soup usually being made from about 40 lbs. of meat. In addition to this mid-day meal, sleeping accommodation is provided for all, so that from Monday morning till Saturday night, there is no necessity for any of the people to leave the premises. Many of the women and children live several miles away, and considering the value of the material which passes through their fingers, the employers give as little encouragement as possible to the operatives, (even though they may live in the immediate neighbourhood), to leave the works during the week days, so that they need not be tempted to take any cocoons or yarn away with them.

Our impressions as to the healthiness and general condition of these operatives were formed before the preceding information, and that which follows, was given to us, or we might otherwise have been led away somewhat, by our feelings or prejudices, to form conclusions different from those already noted.

Hours of labour.

Their hours of labour will remind many factory workers in England of the condition of things in this country 50 and 60 years ago. And yet we should require to go further back in the industrial annals of our country to find a parallel with what we saw and heard. At 5 o'clock a.m. they begin work; at 8 they stop 15 minutes for breakfast; at 12 dinner is served, consisting of soup (supplied by the proprietors), with such additions as the operatives can furnish from their own stores. At 1 o'clock the engine is again started, and continues running without a break till 10 p.m. The evening meal is taken during the intervals of work, and, as many were indulging in it during our tour of the premises, we were able to take note of the kind of food on which these hearty-looking Italian operatives manage to thrive. Many were eating what is known as black bread, without any butter, savoured with garlic, radishes, a little salt, and small turnips. A popular dish was bread sopped in warm water, with a pinch of salt. Polenta, a species of stiff cold pudding made from Indian meal, was being eaten by many, and some were boiling potatoes, with their jackets on, in the cocoon water, and eating them. Rye bread and polenta, are the staff of life among the Italian peasantry, and every girl seemed to have a crust before her. We were informed that delicacies are occasionally indulged in, such as sausages; and

Food.

Liebig's extract of meat is often made into soup, with bread, or is used for sandwiches with bread. Apples, also, and other fruit, are often brought among the week's provisions. At 10 p.m., as already stated, the reeling department of the works ceases, and the labours of the day, for old and young, after continuing for 15¾ hours, exclusive of meal hours, are over. The process is repeated for six days, making a total of 94½ hours for the work of the week, and at 10 o'clock on Saturday night many of the women and children wend their way homeward, to prepare for resumption of work at 5 o'clock on Monday morning. Others, however, who live 10 and 15 miles away, make their pilgrimage on the Sunday morning, bearing with them their bundle, and tired limbs, and wages, and returning from their mountain homes to the factory at night, in order to be ready for work at 5 o'clock on Monday morning.

Sleeping apartments in factory.

The woman in charge of the dormitories seemed anxious to show us the sleeping quarters, and we followed her to one of the rooms containing twenty-five beds, accommodating fifty of the operatives, who sleep two in a bed. The beds consisted of mattresses, with, in many instances, the straw protruding. There were no sheets, but for each bed a rug and a quilt. Here and there was a small box, but there were no tables or chairs. Washing utensils and looking-glasses were conspicuous by their absence; nor were there any arrangements for lighting the apartment. The room was without a ceiling, and the dusty tiles and slanting rafters came down within a few feet of the bedsteads. The spare clothes of the girls were hung on cords which were stretched across the room. Our conductor informed us that at 10 o'clock at night, when the engine stops, the women and children without any delay hasten to their beds. They have no inclination for wasting time over their toilettes. They throw their tired limbs upon their trestle beds, and, without undressing, sleep till they are warned, at 4.45 next morning, that they must be up again and prepare for their work. If they desire the luxury of a wash in cold water there is a trough in the yard; and for ordinary ablutions, as their hands are steeped in warm water from morning till night, they have ample opportunity of washing their faces also.

Health of operatives.

It would not be unnatural to expect that the crowding together of so many operatives, under such defective sanitary conditions, would be attended by great danger to health, and that diseases must be very prevalent. We were, however, informed that, as a rule, the health of the women and children is excellent. There is in this factory a separate dormitory for the sick, but it is very seldom occupied; and during the last eight months' term of work there was not a single case of sickness within the establishment. We were given to understand that when symptoms of illness present themselves, the girls are allowed to make the best of their way to their homes to be nursed under parental control. The most troublesome malady

from which the young people suffer is the well-known 'pellagra,' a skin disease, caused by mouldy food. The polenta brought by the girls from their homes is often made from the worst of the Indian corn, which the farmers are unable to sell in the markets, and which is bought by the peasantry at a low price; and their bread is often so stale and mouldy as to foster the cutaneous disease here spoken of. We did not observe any sufferers, but we had no opportunity of ascertaining the numbers sent home.

Safeguards to preserve morals of females in silk factories.

Although in this establishment 250 operatives are employed, we were informed that the working staff of men consists of two only, the engineer and mechanic, who are known to be thoroughly respectable. So regardful are the proprietors for the morals of the women and children, that even the overlookers are women; men are not employed in any work which women can do, and the greatest care is exercised in securing the good behaviour of the establishment. Some of the girls remain all through the winter months without going to their homes, allowing their wages to accumulate in the hands of the proprietors, who pay them some little interest. Parents come long distances on the pay-day for the earnings of their children, and bring the little ones a supply of bread and potatoes, and leave them to continue their work. As to Factory Acts there are none; and our informant assured us that parents would be the first to resent restrictions. When we asked what education the children receive, we were informed that some of them attend the rural schools during the summer months when the factories are closed, and that in some factories, but not in this one, instruction is given during the dinner-hour. Probably one in ten of the operatives here can read and write a little. Education is not by any means highly esteemed among the poor, and compulsory education, when it is enforced, will be very unpopular.

No Factory Acts.

Education.

Amusements.

Within the factory boundaries, and shut off from the world by a high wall, we were shown a small area of green turf and a few seats. Invariably, when the noontide is sunny, after hastily swallowing their soup and bread, the girls come out here to play, and have merry times while the older ones sit and look on. This one hour in the sunshine of the day (from 12 to 1) is their own, and we were told that it is a treat to see how thoroughly they enjoy it. Often the passing organ-grinder is admitted to the green, and the girls and the younger children dance together with the greatest delight to the strains of the music.

Sixty-five silk factories in one district.

We were informed that in the district in which we saw this factory, there are 65 works of a similar character, of which five, like the present one, are large and important, while the rest are much smaller. The system and organization of the work was said to be the same in all. English tourists, as they wander with so much pleasure through some of the loveliest districts in the north of Italy, little suspect that amid so many outward signs of fruitfulness and plenty, the struggle for existence is only maintained by such unceasing toil. That the poor toilers succeed

in keeping up their healthy looks is a remarkable testimony to their general strength, even when it is remembered that they are able to recruit themselves, after eight months of confinement in the factory, by four months of occupation in the open air.

Silk Dyeing Establishment.—Como.

In the town of Como we visited a large and interesting dyeing establishment, owned by a limited company, and employing 200 workpeople. Dye-works, Como.

At these works upwards of 100,000 kilos of silk are dyed per annum, besides a large quantity of cotton warps.

We were courteously received by the director, and conducted over the several departments by M. Robin, a Frenchman from Lyons, the head of the dyeing shed, who had received his chemical instruction at the Martinière School and the Higher Technical School of that city. All the processes were freely shown to us and were fully described; the cleansing of the gum from the silk, the manufacture of the soap, the departments for dyeing with dye woods, with aniline colours, and the black department, the stores of dyes, the mixing of the colours, the many processes of dyeing, scouring, stoving, and the reloading of the silk with prepared matter so as to restore the weight taken out in the several processes. The machinery was chiefly French, but all modern in plan and construction. Manager a Frenchman.

The men are paid mostly by piece, and earn from 4*s.* to 5*s.* per day of 10 hours; sometimes the best dyers, who are Frenchmen, are paid as much as 8*s.* per day. A few women are employed in the warehouse in folding the yarns and wrapping up the pieces, who are paid from 1*s.* 2*d.* to 1*s.* 6*d.* per day. Wages.

They were using Welsh coal of an inferior quality, which costs about 33*s.* per ton delivered on the premises. Fuel.

Much of the silk yarn which we saw, is sent to England to be woven or made into thread. The bulk of the silk goods here dyed is finally disposed of to two great retail establishments in Paris. Dyed yarn sent to England.

The directors spoke in high praise of the influence of the Technical School of Como. It had materially and beneficially affected the silk industry, by greatly increasing the knowledge both of masters and foremen. A higher culture in designing had led to more variety, more enterprise, and increased trade. A few years ago scarcely anything but the weaving of plain silks was attempted; now there is a growing fancy trade, whose influence is felt in a marked degree at these works, by the greater demand for varied and delicate colours in the dyeing.

MACHINE MAKING.—BIELLA.

Machine factory at Biella.

We were conducted over the works of a prosperous machine-maker and millwright, employing 120 men. Thirty years ago the proprietor had come to Biella as an ordinary working mechanic. He was now one of the important men of the town, and had been very successful. He makes varied kinds of machinery for cotton, wool, and silk, and also supplies mill gearing.

Hours.

Work begins at 7.30 a.m. and continues till 7.30 p.m., with one and a half hours' interval for meals, making a total of 10½ working hours per day.

Military service.

We were informed that the military service greatly interferes with his workmen. The young men leave him at 20, just when they are beginning to be really useful, and many of them never return to him. He states, however, that when they come back at 23 years of age, and again get into harness, there is a general desire, both on his side and theirs, that they should make up for lost time.

Value of the school.

He spoke in the highest praise of the Professional School, and informed us that 20 young men from his works, most of them having already gone through the military service, attend the evening classes, and that he allows them to leave their work on the class nights half an hour before stopping time, without any abatement from their wages.

PART III.

VISITS TO VARIOUS INSTITUTIONS IN THE UNITED KINGDOM.

Technical instruction in the United Kingdom.

Your Commissioners having in the previous portion of their Report described the educational and industrial establishments which we visited on the Continent, now proceed to notice some of the more important kindred institutions which we have inspected in the United Kingdom. As most of these are sufficiently well known, we have dealt briefly with this branch of our subject.

The following is a list of the towns and institutions treated of:—

London School Board.
I. University College.
II. King's College.
III. Normal School of Science, South Kensington, and Royal School of Mines.
IV. Museum of Practical Geology.
V. National Art Training School.
VI. Science and Art Department, as to Examinations.
VII. City and Guilds of London Institute.
VIII. Polytechnic Young Men's Christian Institute.
IX. Royal Indian Engineering College.
X. Royal Naval College, Greenwich.
XI. Crystal Palace School of Engineering.
XII. Oxford.
XIII. Cambridge.
XIV. Manchester.
XV. Liverpool.
XVI. Oldham.
XVII. Barrow-in-Furness.
XVIII. Birmingham.
XIX. Leeds.
XX. Sheffield.
XXI. Bradford.
XXII. Keighley.
XXIII. Saltaire.
XXIV. Nottingham.
XXV. Bristol.
XXVI. Bedford.
XXVII. Kendal.
XXVIII. Glasgow.
XXIX. Edinburgh.
XXX. Ireland.
Dublin.
Cork.
Belfast.
and the West of Ireland.

LONDON.

Science teaching under the London School Board.

London School Board.—Instruction in Elementary Science.—Before passing on to the institutions for scientific, art, and technical instruction, it may be well to state briefly the steps which have been taken by the School Board for London for introducing instruction in elementary science into their schools.

In addition to the object lessons given in the infant schools, the School Management Committee have decided* that elemen-

* See Circular, October 30, 1882.

tary science shall be taught throughout the boys' and girls' departments, in place of the object lessons hitherto given, and their instructions to the teachers, on object lessons, have been modified accordingly.

Model scheme of elementary science instruction, London.

The following is suggested by the School Management Department as a model scheme, but teachers have full liberty to vary it according to their tastes and acquirements:—

Standard I.	Standard II.	Standard III.	Standard IV.
Extension of the object lessons in the infant school, with simple illustrative experiments.	Comparison of different plants or animals. Ordinary phenomena of the earth and atmosphere. Substances of domestic use.	Simple principles of classification of plants and animals. Further phenomena of the earth and atmosphere. Substances used in the arts and manufactures.	More complete classification of plants and animals, with typical examples. The three forms of matter familiarly illustrated.

Standard V.	Standard VI.	Standard VII.
(*a.*) Animal and plant life, with the most useful products; or, (*b.*) More definite notions of matter and force, illustrated by simple machinery or apparatus.	(*a.*) Animal and plant life, with special reference to the laws of health; or, (*b.*) The commonest elements, and their compounds. The mechanical powers.	(*a.*) Distribution of plants and animals, and the races of mankind; or, (*b.*) Light, heat, and electricity, and their applications.

A more detailed description of the courses on physics, mechanics, chemistry, and physiology, has also been prepared by the Board.

Instruction of pupil teachers.

Moreover, courses of instruction in elementary science, have been established by the Board for the central instruction of pupil teachers.

No graded elementary schools in London.

The School Board for London has not as yet established any higher elementary or graded schools, such as exist in Manchester, Sheffield, and elsewhere, having laboratories for the practical teaching of science; nor have they adopted the excellent system, which the Commissioners found at work in Birmingham and in Liverpool, of employing a science demonstrator, who teaches the subjects with practical illustrations in the various elementary schools.

I.—University College, London.

Although the endowments of this college are insignificant compared with those of the colleges of Oxford and Cambridge, and of many modern institutions, yet University College has always stood in the front rank with respect to its scientific teaching, and the recent erection of extensive and well-fitted chemical, physiological, and engineering laboratories, shows that the spirit which has animated the authorities of the college in the past has not suffered diminution. University College.

The Commissioners first inspected the new chemical department under the direction of Professor Williamson, F.R.S., where every convenience for practical work and research is found. The laboratory contains 45 working places, and the block of new buildings, including the physiological section, cost 40,000*l.* The department of applied chemistry under Professor Charles Graham, is of recent foundation; lectures are given on the alkali manufacture, baking, brewing, &c. The practical work in this laboratory is made as far as possible to bear on the various industries. The City and Guilds of London Institute contributes 200*l.* per annum to the maintenance of this department. Chemical and other laboratories.

The engineering department under the charge of Professor Kennedy, was next visited. The laboratory contains a large testing machine, capable of working up to 45 tons. In this department there are 60 students, and the manual work done is confined to the preparation of small specimens for mechanical testing. Professor Kennedy does not attach much value to teaching young men practical work in the school; he is of opinion that they should be taught to draw well, and should be made thoroughly acquainted with the principles of the machines with which they will hereafter have to work. He thinks that it would be a great advantage, if all young men about to become engineers could take part in the practical testing of the properties and strength of materials. Engineering department.

Professor Kennedy is engaged in private practice as a consulting engineer, and the students are often employed on the investigations which he is called upon to perform. The City and Guilds Institute contributes 200*l.* annually to this chair also.

In the physical department under the care of Professor Carey Foster, F.R.S., the tuition is chiefly of a theoretical character, there being very insufficient means of giving practical laboratory instruction. Physical department.

The Slade Art School, under the direction of Professor Legros, is another department of University College. The building for this department is complete and commodious, containing studios for drawing from the life and the antique, as well as lecture rooms, where lectures on anatomy, the science of perspective, the chemistry of colours, &c. are delivered. The school is in a very flourishing state, and is open to female as well as to male students. Slade School of Art.

University College School.

Attached to University College is a very successful high class modern school, under the head-mastership of Mr. H. Weston Eve, containing 600 boys. Considerable attention is paid in the school to the teaching of science, practical laboratory instruction being given in Chemistry by Mr. Orme, (working places being provided for 60 boys), and in Physics by Mr. J. J. Walker.

II.—King's College, London.

King's College, London.

The Commissioners were received by the principal of the college, the Rev. Canon Barry.

Similar remarks as to the value of the scientific and technical instruction, apply to King's as to University College.

Engineering workshops, King's College.

A remarkable feature of this institution are the workshops connected with the engineering department. In these, the students go through a series of exercises in mechanical work. The college course lasts for nine terms, and engineer students passing through this, are said to shorten their apprenticeship by two years. The direction of this department is under Professor Shelley, and the practical instruction is given by Mr. Walker. The course of instruction has more of a workshop character than that at University College. The carpenters' and mechanical shops and smithy are open under certain regulations to the boys from the school attached to the college. In the joiners' shops they learn to make the common joints of carpenter's work, and the fitting of doors and windows, whilst in the engineers' shop they learn wood and metal-turning, chipping, filing, and surfacing.

Chemical laboratories.

The chemical laboratories under Professor Bloxam contain, in the general division 62 working places, and in the advanced 20. There is a distinct department for photographic work under Mr. Thomson.

Wheatstone physical laboratory.

The Wheatstone Physical Laboratory is a noteworthy feature of the physical department, under Professor W. G. Adams, F.R.S. It is large and well arranged for practical work, and a considerable number of students avail themselves of it. A large collection of physical apparatus and several rooms for special experiments are also found in this section of the college. The department of applied fine art is under Professor Delamotte, and in this an attempt is made to apply art teaching to industrial purposes, and students are engaged in designing for china and for woven fabrics.

Mechanical drawing.

The mechanical drawing department is under the charge of Professor Glenny.

III.—Normal School of Science and Royal School of Mines, South Kensington.

Royal Normal School at South Kensington.

The Commissioners visited the Normal School at South Kensington, and were received by the Registrar, General Martin, who accompanied them over the building.

This school, which was reorganized in 1881,* gives systematic instruction in mathematics and mechanics, physics, chemistry, biology and botany, geology and mineralogy, agriculture, metallurgy and assaying, elements of astronomical physics, practical geometry, and mechanical and freehand drawing. Mining is taught at the Museum of Practical Geology in Jermyn Street, but forms part of the Normal School. The Normal School is primarily intended for the training of science teachers, and the instruction of students of the industrial classes, selected by competition in the annual examinations of the Science and Art Department; but other students are admitted on payment of prescribed fees. The students may be (1) occasional students and (2) regular students who are preparing for the associateship of the school, and pass through a prescribed course extending over 3 to 3½ years. The instruction for the first two years for all the associate students is the same, and includes mechanics and mathematics, physics, chemistry, elementary geology, astronomy, mineralogy, and drawing. The student then elects to take up one of the following divisions, to which the remainder of his course is directed: viz., for the title of Associate of the Normal School of Science, I. Mechanics, II. Physics, III. Chemistry, IV. Biology, V. Geology, or VI. Agriculture; and for title of Associate of the Royal School of Mines, either VII. Metallurgy, or VIII. Mining.

Courses for associates.

There are 12 exhibitions each of the value of 50*l.* per annum tenable at this school, and continuing during the course of tim (3 to 3½ years) necessary for the preparation for the associate ship examination. The exhibitioners have also free admission to the lectures and laboratories. Three or four are vacant each year, and are competed for at the May examinations of the Science and Art Department. Six free studentships are also similarly annually competed for. These correspond to the exhibitions, except in so far that they carry no money grant.

Exhibitions.

Free instruction is likewise given to local exhibitioners, who hold scholarships of the value of 50*l.* per annum, half of which sum is subscribed by the locality, and half by the Department. There are also royal scholarships, four of 15*l.* for first year students, and two of 25*l.* for second year students.

About 50 science teachers, or students intending to become teachers, also receive free instruction, and in addition are paid the railway fare to London, and receive a maintenance allowance of 21*s.* a week whilst under instruction.

Classes for science teachers.

* For history of the school, see Prof. Huxley's evidence (Answer 3070.)

Summer courses for science teachers at South Kensington.

During the summer vacation, short courses of lectures, extending over three weeks, are given to science teachers, about 200 in number, who are aided by the Department in the payment of the expenses of the journey to, and residence in, London during the progress of the course.

Courses of popular evening lectures for working men are also given by the professors.

Laboratories.

The Commissioners first visited the Metallurgical Laboratory which had recently been fitted up in the basement of the building. The Chemical Laboratories under the charge of Professor Frankland were inspected, and also the Physical Laboratory of Professor Guthrie and the Physiological Laboratory under Professor Huxley. The Commissioners had conversations with the professors, on the system of science teaching adopted in the school.

Biological section.

Professor Huxley, the Dean of the School, explained the methods of practical and theoretical instruction given under his guidance in the department of biology, which includes an important museum and a large collection of preparations and

Geology.

diagrams arranged for the special purposes of study. Pure and applied geology under Professor Judd forms an important feature of the science instruction, and the students are brought into close contact with the subject by the microscopic preparation and examination of rock sections and other practical geological

Physical instruction.

work. Professor Guthrie explained the way in which he had introduced laboratory work in physics; every student having to

Metallurgical laboratory.

construct certain simple physical apparatus. Professor Chandler Roberts stated that in his department (that of metallurgy), there were 30 working places. Since coming to South Kensington he had had a large addition of students, and there were now 40 under instruction, and it needed much ingenuity to arrange the places for them. In the chemical department the numbers have slightly fallen off.

IV.—Museum of Practical Geology and Royal School of Mines.

School of Mines, Jermyn Street.

On the occasion of their visit to the Museum in Jermyn Street, the Commissioners were received by Professor Warington Smyth, F.R.S., and Mr. Rudler, the curator. Since the transfer of the School of Mines to South Kensington in 1881, the practical science teaching, except in the case of mining students who take part of their instruction here, has virtually ceased. Evening science lectures for working men take place during the session; the charge for admission to each course of lectures is 6*d*. There is a good library, a small chemical laboratory, a lecture theatre, and the necessary class-rooms.

Geological collections.

The geological collection first known as the Museum of Economic Geology, was transferred to Jermyn Street from Craig's Court in 1851. The museum was designed to illustrate

mainly the geology of Great Britain and Ireland, and to show the applications of geological science. It contains specimens of minerals, including the ores of the useful metals, and models representing metallurgical processes. The various arts connected with the mineral resources of the country are illustrated by specimens showing varieties or peculiarities of manufacture. An excellent historical collection of English pottery and porcelain has been added, and there is a very complete series of English building stones.

The collection of models of mines, mining tools, and mining machinery is very extensive. All the varieties of safety lamps are shown. Models, &c.

The Mining Record Office, which was formerly situated at Jermyn Street, was transferred to the Home Office in 1882.

The Offices of the Geological Survey of Great Britain are also at the Museum.

V.—National Art Training School.

The School of Design which, in 1853, was removed to Marlborough House from Somerset House, has been established since 1856–7, at South Kensington, as the National Art Training School. National Art Training School.

An important change has taken place in the conduct of the school since 1871, when, in order to fulfil more efficiently its primary object of training teachers, an entrance examination was imposed. In the year 1880–1 there were 128 students (94 males and 34 females) attending the school without paying fees, 47 students were admitted on payment of half-fees, and from 759 students (359 males and 400 females) the sum of 3,022*l.* was received in fees. The course of instruction includes 23 stages, in the highest of which, stages 22 and 23, the student takes elementary and applied design.

Certificates of competency to teach the subjects comprised in these various stages of instruction, are given to candidates who pass the necessary examinations. These are— Certificates of competency.

(*a.*) The preliminary or art teacher's certificate.

(*b.*) Art certificates of the third grade.

The Commissioners, accompanied by the principal, Mr. Sparkes, inspected the various class-rooms, and examined the work in progress. The more advanced students draw and model from the antique and from the life. We were present at a lecture by Mr. Stannus, on decorative art; and, on a subsequent visit, when we were accompanied by the Director for Art, Mr. T. Armstrong, we were shown the designs for industrial purposes made by the students of the training class, among which were specimens of designs for metal work, wood carving, goldsmiths' work, pottery, and the interior decoration of buildings. These designs are worked out in competition among the students. Designs for Industrial Art.

VI.—Examinations under the Science and Art Department, South Kensington.

Science and Art Examinations.

Examinations in art, in connection with the Science and Art Department, date back to 1853, though the existing comprehensive plan of annual examinations was not established until 1857. In that year, 12,509 students were instructed in local schools of art, and 396 in the Central Training School, and through the various agencies connected with the Department, 43,212 children in elementary and other schools were taught drawing. No general system of examinations in science was formulated until 1859, when the number of subjects, on which payment could be obtained, was limited to six. In May 1861, when the first general and simultaneous science examination was held, there were 38 classes with 1,330 pupils, besides some 800 pupils in classes not under certificated teachers.

Examinations in Art.

In the year 1882, there were in all 909,206 persons receiving art instruction in connection with the Department, and 68,581 students in science, in 1,403 science schools, with 4,881 classes.

The Examinations in Art are of three grades, the first grade being intended for children attending the elementary school, the second grade for the pupils of secondary schools and the students of art classes and schools of art, and the third grade is applicable for teachers or art masters.

Examinations in science.

Science Examinations are held in 25 subjects; the examinations take place in May, and are divided into three stages; the "elementary," "advanced," and "honours." In each stage there are two grades of success.

System adopted.

On receipt of proper demands from local authorities, papers, both for the science and art examinations, are forwarded from South Kensington to the centres where the examinations are conducted. The worked papers are sealed up directly after the examination, and forwarded to London. On the result of these examinations, prizes and scholarships are awarded to the successful students, and money payments are made to the local committee, which vary in accordance with the degree of success attained by the students, and with the nature of the subject.

Amount of annual grant.

The total payments in the year 1882–3, on account of science schools and classes, grants, prizes, etc., was 45,376*l.* 0*s.* 6*d.*, and for success in art the amount was 67,354*l.* 10*s.* 6*d.*

The total expense of the Science and Art Schools is returned at 155,367*l.* 5*s.* 4*d.* for the year 1882–83, exclusive of the staff of the department, who received 8,898*l.* 4*s.* 10*d.*

VII.—The City and Guilds of London Institute.

This Institute has been established by the City Livery Companies, for the purpose of providing and encouraging education adapted to the requirements of all classes of persons engaged, or preparing to engage, in manufacturing and other industries. General objects.

With this object the Institute subsidises existing educational establishments, which, in the opinion of the Council of the Institution, are providing sound technical instruction, and which would possibly languish except for external aid.

It also encourages, in the principal industrial centres of Great Britain, the formation of evening classes, in which workmen and foremen, engaged in their several factories during the day, receive special instruction in the principles of science, in their application to the processes with the practical details of which they are already familiar.

It aims at establishing and maintaining in the Metropolis model technical schools, to serve as types of other schools to be founded and supported by local efforts in provincial towns; and, lastly, it is erecting a Central Institution, corresponding to some extent to the great Polytechnic Schools of Germany, Switzerland, and Italy, and to the École Centrale of Paris.

With this varied programme, the City and Guilds of London Institute is assisting in the professional instruction of all classes of persons engaged in industrial operations,—of artizans, apprentices, foremen, managers of works, manufacturers, and technical teachers.

The Council of the Institute have no intention of interfering with any existing social institution, such as apprenticeship, or any other relationship between employer and employed, but aim only at supplying the want of further instruction which is everywhere felt to exist, by supplementing, and by preparing pupils more thoroughly to profit by, workshop training.

For the establishment of technical classes in the Metropolis and in provincial manufacturing towns, the Institute has granted for a period of years the following annual subventions:— Subventions to technical institutions.

£	
400	to University College, London.
400	„ King's College, London.
350	„ Horological Institute.
250	„ School of Art Wood Carving.
300	„ Firth College, Sheffield.
300	„ University College, Nottingham.
200	„ Technical School, Manchester.

In addition to these annual grants, it has given 700*l.* for the establishment of a Technical School in Leicester, as well as 200*l* to Nottingham, and 100*l.* to Manchester for the purchase of mechanical appliances, besides other smaller grants.

Classes in Technology of City and Guilds Institute.

In nearly all the large manufacturing towns, evening classes in Technology, as distinguished from the Government classes in Science and Art, are being assisted by the Institute. The work done by the students of these classes is inspected and examined by the Institute, and, on the results of the annual examinations, certificates and prizes are granted, which are beginning to be regarded as diplomas of proficiency, and are said to enable operatives to obtain better employment and higher remuneration. These evening classes have already become, and are likely in future to become still more, the nuclei of technical colleges, mainly supported by the towns in which they are situated, but connected with, and affiliated to, the City and Guilds of London Institute, by means of its examinations and superintending influence.

Technological Examinations.

According to the Programme of Technological Examinations for 1883–84, examinations are held in the following subjects:—

1. Alkali and allied branches.
   - A. Salt manufacture.
   - B. Alkali ,,
   - C. Soap ,,
2. Bread-making.
3. Brewing.
4. Distilling—
   - A. Coal tar distilling.
   - B. Spirit manufacture.
5. Sugar manufacture.
6. Fuel.
7. Oils, colours, and varnishes, manufacture of.
8. Oils and fats, including candle manufacture.
9. Gas manufacture.
10. Iron and steel manufacture.
11. Paper ,,
12. Pottery and porcelain ,,
13. Glass ,,
14. Dyeing—
   - A. Silk.
   - B. Wool.
15. Bleaching, dyeing, and printing of calico or linen.
16. Tanning leather.
17. Photography.
18. Electro-metallurgy.
19. Textile fabrics, manufacture of—
   - A. Cloth.
   - B. Cotton.
   - C. Linen.
   - D. Silk.
   - E. Jute.
20. Lace manufacture.
21. Weaving and pattern designing.
22. Electrical engineering—
   - A. Telegraphy.
   - B. Electric lighting and transmission of power.
   - C. Electrical instrument making.

23. Metal plate work.
24. Plumbers' work.
25. Silversmiths' work.
26. Watch and clock making.
27. Tools—
    A. Wood working.
    B. Metal working.
28. Mechanical engineering.
29. Carriage building.
30. Printing.
31. Ores, mechanical preparation of.
32. Mine surveying.
33. Milling (flour manufacture).
34. Carpentry and joinery.

Originally established by Society of Arts.

These examinations were originally established by the Society of Arts, but were subsequently taken over and considerably modified and developed by the City and Guilds of London Institute. In 1879 the number of candidates was 202, and the examinations were held in 23 different places. In 1883, 2,397 candidates presented themselves from 154 centres in different parts of the United Kingdom.

Finsbury Technical College.

The Finsbury Technical College, which was opened on 19th February 1883, has been erected, at a cost of about 36,000*l.*, to serve as a model trade school for the instruction of artizans and of other persons preparing for intermediate posts in industrial works. It consists of a school of applied science and art. There is a day and an evening school. The latter provides systematic instruction for those who are engaged in the staple industries of the district, including cabinet-making; and in the applications of chemistry, mechanics, and physics, to special trades, such as spirit rectification, mechanical engineering, electric lighting, &c. An approach has been made to the establishment of a relationship between this College and the principal middle class schools of the Metropolis, by the award to selected pupils from these schools of exhibitions enabling them, without payment of fees, to receive in the College scientific and technical training, fitting them for various occupations and industries, as well as for higher technical instruction.

The subjects taught comprise mathematics, pure and applied, practical mechanics, chemistry, physics, electrical technology, freehand, model, and machine drawing, workshop practice, French and German; and in the evening additional classes are held in carpentry and joinery, metal-plate work, bricklaying, drawing, painting, modelling, and design.

South London Technical Art School.

The South London Technical Art School, situated in the Kennington Park Road, provides instruction for artizans engaged in various industries in which art aptitude is indispensable to success. The courses are for evening and for day students, for men and women. The subjects of instruction include drawing, modelling and painting from life, wood-engraving, china-painting, enamelling, and design.

Central Institution of City and Guilds Institute. Objects.

The Central Institution in the Exhibition Road, now in course of construction, is intended to give to London a first-class college in which technical teachers for the provincial schools may be educated, and in which those who are to be engaged in the superintendence of great industrial works may receive their preliminary training. The establishment of this Central Institution will, it is hoped, render unnecessary the recourse to foreign countries (where similar institution salready exist) for the technical instruction of managers of works, engineers, and industrial chemists, and will be welcomed by manufacturers, who feel the want in London of some such institution, in which their sons who are to succeed them can obtain as good an education as at Paris, Zurich, Munich, or Berlin. Just as the École Centrale at Paris is about to be removed to the immediate neighbourhood of the Conservatoire des Arts et Métiers, in order that the students may be near to the collections of machinery and other industrial objects which the Conservatoire contains; so the Central Institution of London is built near to the Science Schools and National Museums of South Kensington. Besides giving to the Metropolis a Technical High School or Technical University for advanced instruction in the applications of science and of art to industrial operations, the Central Institution, as a training school for teachers, as a focus for uniting the different technical schools now in existence, and as a centre for the dissemination of technical knowledge, is expected to be the means of increasing the efficiency of every department of the Institute's work.

Cost.

It is estimated that the Central Institution, with its fittings, &c., will cost about 95,000*l.*, of which sum the Council of the Institute have been able to provide about 75,000*l.* by accumulated savings and by grants from several of the Companies as indicated in the report. There is a deficit of about 20,000*l.* now needed for fittings, furniture, and apparatus, which the Council have at present no means of supplying.

The Central Institution, Exhibition Road.

The Central Institution.—The foundation column of the Central Institution was placed by His Royal Highness the Prince of Wales, President of the Institute, on the 18th July 1881.

Description of the building.

The building has a frontage of 300 feet in the Exhibition Road, on the opposite side to the South Kensington Museum, and closely adjoining the Natural History Museum, designed by the same architect, Mr. Alfred Waterhouse, A.R.A., of London. The exterior is of a semi-classic character, and the arms of the principal manufacturing towns in the United Kingdom are displayed in strong relief upon its front.

It is, for the most part, five stories in height. In the basement are physical laboratories and mechanical workshops, three very large shops at the back being top-lighted. The entrance-hall is in the centre of the building, and leads to the great corridor which stretches from one end of the building to the other. Mechanical class-rooms, physical class-rooms, a museum for industrial apparatus, and a room for the teaching of mathematics are on three floors. There are also at the back of the building two

large lecture-theatres, lighted principally from the sides; one being for chemistry and the other for physics and mechanics.

On the first floor, over the entrance, is a large reading-room and library, with experiment rooms and class-rooms on each side of it. The offices for the administration are towards the north end of the building, terminating in the council-chamber, a handsome apartment, on the walls of which it is proposed to emblazon the arms of all the Livery Companies. On the second floor an art museum occupies the principal position in the centre of the building, with class-rooms and lecture-rooms on each hand. On the third floor, above the art museum, is a large room, 67 feet by 35 feet, with a fine semi-circular roof, to be used as a museum of technology. At one extremity of the building is a refreshment-room for students and others engaged in the building. At the opposite end is a large special laboratory adjacent to the general chemical laboratory, underneath which are two additional laboratories for special purposes.

There is space for an additional wing at the south end of the building, corresponding to that at the north end, which contains the chemical department and the lecture theatres.

The scheme for the organization of this institution will be found in the Appendix, Vol. IV.

Finsbury Technical College.

The Technical College, Tabernacle Row, Finsbury, London.— This institution, founded by the City and Guilds of London Institute, gives technical instruction, both day and evening, of a character suited to the requirements of artizans and others. Practical laboratory work in the subjects taught, forms a special feature of the system of instruction.

Courses of instruction.

A complete course of instruction has been drawn up for the day students and for those attending the evening classes. The students can enter into any one of the following departments:—

(1.) Mechanical engineering.
(2.) Electrical engineering.
(3.) Industries involving applications of chemistry.
(4.) Building trades.
(5.) Applied art industries.

There are at present about 100 students attending the day school, and upwards of 600 students attending the evening school. The fees for the complete course of day instruction are at present as follows:—

Annual payment, 9*l.* in one sum, or 10*l.* in three instalments. For the evening courses the fees range from 5*s.* to 30*s.*

The course extends over two years, and it is proposed to give certificates to those students who go through the entire course satisfactorily.

Evening instruction.

Evening Instruction.—The Commissioners visited this institution and the adjoining Middle Class School in Cowper Street on two occasions. They were met by Mr. W. P. Sawyer and Mr. Owen Roberts, two of the Honorary Secretaries, and some members of the committee, and inspected, in the first instance, the evening classes of the college. They were introduced to

Physical department, Finsbury Technical College.

Professor Ayrton, the teacher of physics and electricity, who conducted them over the various rooms in his department, eight of which are devoted to the laboratory work of the students.

One of these contains dynamo-machines, worked either by the main steam engine of the building or by a gas engine in the room. There is one large Edison dynamo-machine used for lighting the building, and students were engaged in making original experiments on some of the others. The second room is used for experimenting on accumulators, taking photometric measurements of electric lamps, &c. The third room is fitted up for delicate experiments, such as measuring the insulation and capacity of submarine cables, the instruments standing on pillars carried up from the basement. These three rooms are all used by second and third year students of electrical engineering.

Electrical engineering.

The fourth and fifth rooms are fitted up for an organized series of experiments for first year students of electrical engineering; one of the rooms being for experiments in current electricity, and in static electricity. The peculiarity of the arrangement adopted is that each experiment has all the apparatus required for performing it ready in position, together with printed instructions. The students work in groups of three. This arrangement enables the very large numbers, who only come to the laboratory for a couple of hours at a time, to work together, and to complete, or nearly complete, one experiment during that time, which would be quite impossible if the students had to search for the necessary apparatus, resistance coils, batteries, &c., and to fit them up. The instruments needed for each experiment, completely fitted, are mounted on a board, which can be taken into the lecture room for use during the lectures. The sixth room, which is a small one, is fitted up for plotting curves, recording the results of experiments. The seventh room is used for experiments on heat, and the eighth is fitted up as a workshop for the manufacture and repair of physical apparatus, where a skilled workman is constantly engaged.

The Commissioners found students working in four of these rooms, which are more or less completely fitted with apparatus. The remaining rooms were not occupied, as the apparatus had not as yet been obtained for furnishing them.

Lecture theatres.

The basement is well lighted, all the walls being lined with white glazed bricks. The first floor, which is very lofty, contains two large lecture theatres, each capable of seating 200 students. They are so arranged that the line of seats rises in the form of a curve, giving every student a good position for seeing the experiments of the lecturer. The black-boards behind the lecture table are so balanced as to be capable of being moved up or down with the least possible effort. The building and class-rooms throughout are lighted by means of Edison's incandescent lamps, but Siemens' gas lamps have been provided in some parts of the building.

The chemical laboratories are on the second floor. Here the Commissioners were introduced to Professor Armstrong, who explained the considerations by which he had been guided in the planning of the laboratory. The room is divided into two parts by double glass screens, between which are the arrangements for the supply of sulphuretted hydrogen for the use of the students, the elementary and the advanced. The former contains 43, and the latter 51, working places, each of which, however, has two drawers and two cupboards, and is, therefore, available for two students working at different times. The entire bench is covered with a hood, at the top of which are openings at intervals communicating with a chimney in which there is a powerful draught, produced [illegible] means of the waste heat from the boilers, so that all gases and [illegible] in the experiments are said to be drawn away [illegible] intended that by these means the [illegible] wards [illegible] a d re [illegible] e- in ry, om sts. iem ions in- two ude, nsti- very tead, e, to gas ively, esults he is actical ienced results t their soning

Chemical department, Finsbury College.

of their ex[illegible]
previous education has [illegible]
faculties.

Students in the chemical department are required to devote a considerable amount of time to mechanical drawing and other mechanical subjects, so that they may become competent to deal with machinery.

Evening art classes at the Technical College, Finsbury.

Art Department.—The Commissioners next visited the art classes under the Institute, which are held in the basement of the middle-class school at Cowper Street, temporarily used for the technical college. Here Mr. A. Brophy, the head master, has special classes for cabinet-makers, designers, and others. He explained his system of teaching to be that each student not only prepared an outline from a copy, but had subsequently to ink it in, or complete it in colour, so as to form a simple design for inlaid work or some other kind of decoration. He tries, as far as possible, to set before his students copies from the best work of former days, so as to give them a means of acquiring a certain amount of the history of art while they are learning drawing. Thus a number of pupils who were studying drawing with special reference to lithography, were sketching in pen and ink from Dürer woodcuts. In a second room practical designing was being taught, the students being engaged in applications of design to various materials, pottery, colour printing, &c.

The room for drawing from the life was occupied both by male and female students, who were drawing from the draped female model. In another room students were engaged in modelling from the life, also from the draped female figure.

Mr. Brophy stated that he allowed his students to select what class of drawing or modelling they wished to learn, and to go at once, if they could draw at all, to that particular work. He was averse to spending time over carefully finished drawings, and preferred that his students should begin at once with something that interested them, and that they should also, from the first day, practise the use of colour.

Small classes engaged in mechanical drawing, building construction, and practical drawing for carpenters, were also inspected.

Day classes at the Finsbury College.

Mechanical laboratory.

Day School.—The Commissioners subsequently visited the day department at the Technical College. Professor Perry, the teacher of practical and applied mechanics, showed them the work carried on in his department. In the mechanical laboratory, besides the well-known experiments with the triangle and polygon of forces and other pieces of apparatus described in many books on mechanics, a graduated series of experiments is arranged, by means of which students investigate for themselves the effect of different loads in various machines, of bands on pulleys, and so forth.

Among other experiments of the series are those on the energy of a rotating body; the resistance of wire to extension and torsion, and of beams loaded and supported in various ways, and of the vibration of the pendulum, &c.

The apparatus is nearly all of a novel kind, the student making a complete set of observations of one arranged experiment before he passes on to the next, and the sheets of squared paper, &c., containing the results of his observations, with short descriptions of what he has actually done, are retained by the

student to help in fixing his position in the class list at the end of the session. Professor Perry stated that the investigations of some of the students were of considerable interest and originality.

Workshops.

The Commissioners then saw the workshops. In the carpenters' shop, fitted with benches and lathes, the students were at the time of our visit engaged in making freehand sketches from parts of machinery, which they were subsequently to draw to scale in the drawing room. In the adjoining shop for metal work, fitted up with vices, lathes, and some small machine tools, they were chipping iron. These two workshops are in the charge of a practical mechanic.

Professor Perry showed the Commissioners the engine and boiler fitted up under his superintendence, to drive the dynamo-machine and to furnish the motive power for the building. This has been specially arranged for experimental purposes. The boiler and engine are to be provided with appliances for measuring evaporation, steam temperatures, flue temperatures, steam pressure, condenser temperatures, feed-water temperatures, &c. The shafting is provided with two dynamometer couplings, and the engine is capable of being worked either with or without condensation. A special "evaporative" surface-condensing apparatus in connection with the engine is fitted up on the top of the buildings, by which means a considerable vacuum is obtainable.

Drawing school and Museum.

The Commissioners then visited the drawing rooms for mechanical drawing, and the large apparatus room or museum on the first floor.

Course of instruction.

Nearly all the students of the day department follow out the complete course of instruction as laid down in the programme. They come at 9.30 in the morning and remain at the College till 5 in the afternoon, a half-hour being allowed in the middle of the day. All the students undergo a practical course of science instruction in the chemical, physical, and mechanical laboratories. They also learn freehand and machine drawing, and one modern language. Each student spends at least three hours per week in the workshop. The students are admitted only after passing an entrance examination in elementary mathematics. The Cloth-workers' Company have given two exhibitions of 30*l.* to the London School Board; one to be awarded annually, and to be available for two years, to a selected pupil from the elementary schools, who, after receiving some preliminary science training, shall pursue his studies at the Finsbury Technical College. By means of these exhibitions and of others tenable at the Central Institution, the Council of the Institute hope to see the way open to boys of exceptional merit from the primary schools, enabling them to receive the highest technical instruction.

Technical Art School, Kennington.

City and Guilds of London Technical Art School, Kennington Park Road, S.E.—The Commissioners visited this school and were received by Mr. Owen Roberts, one of the honorary

secretaries of the City and Guilds of London Institute, and by Mr. Sparkes, the superintendent of studies.

School of wood engraving, Kennington.

This school is carried on in two dwelling-houses which have been thrown into one for the purpose, and large top-lighted class rooms have been built in the rear, for drawing from the life, and for modelling. The department first visited was that for wood engraving. This class, which meets daily, except Saturdays, from 10 to 4, and each evening from 6 to 8, is under the care of Mr. C. Roberts. The students, 11 in number, at the time of our visit, were engaged in practical work, at circular tables specially fitted for the purpose. Four students work at each table, which has an elevated block in the centre for the lamp and glass water lenses. The students are required before entrance to have taken the Second Grade certificate of the Science and Art Department. One evening in each week is set apart for drawing on the wood.

Elementary design.

In the class for elementary design, under Miss Walford, the students were all women who were engaged in making designs for tile, wall paper, and other decorative work; the instruction includes, (1) drawing flowers, foliage, and natural forms; and (2) the arrangement of these studies in elementary designs.

Advanced design.

The advanced class of design is under the tuition of Mr. Hugh Stannus, and at the time of our visit, he was lecturing on design suitable for encaustic and other tiles, to a class of about 15. This course is adapted to students engaged in the practice of ornamental art, and to lithographers, engravers, house decorators, and designers for textile fabrics, pottery, and surface decoration.

Life study.

In the life room, next visited, a large number of students were making drawings from the nude model; the work, as a rule, was in charcoal, and the aim seemed rather to produce rapid and effective sketches than laboriously finished drawings. The room was almost inconveniently crowded. Some of the students here seemed to have scarcely sufficient power of drawing to be working from the nude. It is a rule in most schools to require that the student, previous to attempting to study from the life, should have some considerable skill in drawing.

Modelling and china painting.

In the modelling room some good work was being done, especially from drapery and in bas relief. We were told that a large number of the students were practically engaged in modelling during the day time in the Lambeth potteries. A class for china painting meets here during the daytime twice a week. The attendance during the past year has been as follows:—

Subject.	Males.	Females.	Total.
Modelling	48	9	57
Design, elementary	4	28	32
,, advanced	9	10	19
Wood engraving	4	12	16
Life classes, drawing and painting	20	9	29
	85	68	153

The following have been the occupations of the students recently attending the school:— Occupations of students of the Technical Art School.

Designers	60
Wood engravers	30
Stone carvers	37
Teachers	19
China painters	12
Wood carvers	10
Modellers	10
Clerks	10
Art students	8
Tradesmen	8
Draughtsmen	4
Lithographers	3

VIII.—The Polytechnic Young Men's Christian Institute. Regent Street, London.

The Commissioners were received by Mr. Quintin Hogg and Mr. Mitchell, the secretary. Mr. Hooper, a member of the committee, also accompanied them. They were conducted by these gentlemen through the various class-rooms, and Mr. Hogg explained to them briefly the origin of the Institute. The work was started many years ago as a philanthropic effort, and in its first form took the shape of a ragged school, which ultimately developed into the Young Men's Christian Institute, and the building in which the lectures and classes were now being carried on had been purchased by Mr. Hogg for the purpose. Objects and origin of the institution.

The Institute numbers 2,000 members, which is the maximum number admitted, but there are 1,200 applicants awaiting the opportunity of admission. Youths between the age of 16 and 23 are eligible for election, but as the Institute is principally intended for apprentices and young artisans, only 20 per cent. of persons not belonging to the artizan class are admitted at any one election. The subscription is 3*s.* 6*d.* per quarter, and a small fee on joining the various classes. In certain cases outsiders are admitted to the classes on payment of double fee, but, practically, three-fourths of those attending the classes are members of the Institute. Special efforts are made by the Committee to provide the members with the opportunity of acquiring a sound theoretical and practical knowledge of their various trades, and care has been taken that the instruction should not be too difficult to be understood by the average mechanic. Number of members.

The following is a list of the systematic trade courses given, with the syllabus of subjects taught, but there are also practical class for other trades as will be seen from the account. Nearly all these classes are in connection with the City and Guilds of London Institute, their teachers being registered by the Institute and receiving payment on results. Trade courses. Courses of instruction.

Classes at the Polytechnic Young Men's Christian Institute.

Bricklaying.—Practical, Plane, and Solid Geometry, Building Construction, Practical Mensuration, Elementary Sanitary Engineering, Practical Bricklaying.

Metal Plate Work.—Freehand and Model Drawing, Practical, Plane, and Solid Geometry, Theoretical and Applied Mechanics, Metallurgy, Metal Plate Pattern Cutting, Metal Plate Work.

Electrical Engineering.—Geometry, Machine Drawing, Mathematics, Magnetism and Electricity, Applied Mechanics, Acoustics, Light, and Heat; Telegraphy, Electric Lighting, Electric Instrument Making.

Engineering.—Geometry, Mathematics, Machine Construction, Theoretical and Applied Mechanics, Pattern Making, Steam, Mechanical Engineering.

Plumbing.—Geometry, Building Construction, Elementary Chemistry, Sanitary Engineering, Applied Mechanics, Plumbing.

Watch and Clock Making.—Practical, Plane, and Solid Geometry, Machine Construction and Drawing, Mathematics, Theoretical Mechanics, Applied Mechanics, Watch and Clock Making.

Carriage Building.—Freehand and Model Drawing, Practical, Plane, and Solid Geometry, Mathematics, Theoretical and Applied Mechanics, Carriage Building.

Electric lighting class.

The Commissioners first visited the class, numerously attended, for electric lighting. We then inspected the class for photography, in which practical demonstrations were being given.

Photography.

We next proceeded to a large class for tailors' pattern cutting, the work being done in chalk on cloth strained over tables, and the cut patterns being made in brown paper.

Tailoring.

The teacher, Mr. Humphreys, a self-trained cutter, stated that he had himself invented the methods by which he worked, after carefully studying all the plans adopted in America, Germany, and elsewhere. After having been many years practically engaged in the trade as a foreman cutter, he now entirely devoted himself to literary work, editing a trade paper with fashion plates and patterns, which appears monthly, and teaching classes in the evening. So numerous had been the applications for membership of this class that upwards of 100 students had to be turned away.

Printing.

The next class was one for printing. Here the teacher was explaining the composition of printers' rollers, and giving practical instruction for their preparation. Thence a visit was paid to the class for shorthand writing, and next the workshops were inspected.

Plumbing.

The class actually at work at the time of the visit was that for plumbers' work, the making of all kinds of lead joints was in progress, and practical plumbing of every kind was going on under the teaching of Mr. Davies, the foreman of a large firm in the trade. Various other classes for practical

work are held on different evenings; thus, for instance, metal turning and wood turning, cabinet-making, carpentry, &c. In the class for tinplate working, which was next visited, Mr. Millis, the teacher, stated to the Commissioners that his instruction was chiefly theoretical, and that he did not consider it necessary to include practical work, as is done in the plumbing class. The drawing and modelling classes, which seemed almost overcrowded, were next visited. The drawing was chiefly outline and shading from casts, but some few of the students were attempting to apply their knowledge to designing, and work of a more advanced character. A theoretical class was also inspected by the Commissioners, in which instruction was being given in watchmaking by Mr. Herrmann.

Tinplate working.

Drawing and modelling.

Watchmaking.

After a brief inspection of the library and reading rooms, the recreation room, and the arrangements in the basement for lavatories, cloak rooms, &c., the Commissioners adjourned to the large hall and witnessed a display of fencing and gymnastics by some of the more proficient members of the association. Mr. Hogg explained that one of the great attractions of the Institute was the gymnasium, which was largely patronised, and for which members paid an additional fee of sixpence per quarter. He encouraged them to come in their working clothes directly after leaving work, and to spend the whole of the evening at the Institute, refreshments being provided at a moderate cost, and recreation and teaching being jointly cared for. In addition to the teaching on the week-days, the largest adult Bible class in the world (Mr. Hogg believed) is held on the Sunday, when he has an average attendance of 650 young men in one class. In order to give them a sufficient amount of outdoor exercise, he had leased a field of 13 acres at Barnes, for cricket, lawn tennis, football, &c., and he made a practice of inviting all the members of the Institute to stay with him in the country for a week every summer. He could arrange to receive fifty at a time.

Other spheres of usefulness of the Institute.

The Commissioners understand that Mr. Hogg has expended 80,000*l.* in the purchase, fitting, and endowment, of the Institute.

IX.—Royal Indian Engineering College, Cooper's Hill.

The Commissioners visited the Royal Indian Engineering College, at Cooper's Hill, near Staines, and were received by the President, Gen. Sir Alexander Taylor, K.C.B., and Professors Reilly and Unwin, who explained the objects of the institution and the aims and scope of the teaching. It is now nearly two years since the school was thrown open to students training for the engineering profession generally, having been till then specially maintained by the Indian Government for

Royal Indian Engineering College.

Royal Indian Engineering College, Cooper's Hill.

the education of engineers for the Public Works Department of that country. It was established in 1871. Formerly students were required to submit to a competitive entrance examination and, at the completion of their training, were entitled to demand employment in India. Now a qualifying examination has taken the place of the competitive one, and while a certain number of Indian appointments are thrown open annually, students attending the college do not bind themselves to enter the Indian Government service. Owing to the doubt which prevailed some years ago respecting the continuance of the school, the numbers fell off considerably, and at the present time there are only 80 students, the college being well adapted for 120. The course extends over three years, and the curriculum consists principally of mathematics, physics, and drawing, besides the subjects of a good general education. The distribution of the work will be seen from the programme in the Appendix.

Subjects of study.

Laboratories.

The Commissioners visited the class rooms, the lecture-room and drawing-room, and the chemical laboratory. Chemistry is at present an optional subject, but after this year it is intended to make it compulsory. The laboratory now contains only 12 working places, but the buildings needed to double it in size are in course of erection. A large new physical laboratory is also about to be built. At present the physical teaching is all given in class, and no experimental work is done. A very handsome drawing school is also being constructed, and the old drawing school will be partly used as a physical lecture room. A visit was paid to the workshops which contain a good collection of lathes and small machine tools driven by a steam engine. Beyond the engineering workshop is a small carpenters' shop, principally used for pattern making. The workshop instruction is optional, and is taken out of school-hours. The workshops are under the charge of Professor Reilly and the work-master, Mr. Hopps, who has given evidence before the Commissioners. A mechanical laboratory is also in course of construction, which it is estimated will cost upwards of 2,000*l*. It will contain a testing machine capable of testing up to 100 tons, a gas engine, some small shaping machines for making specimens for testing, &c. This department is in the charge of Professor Unwin.

Drawing school.

Workshops.

Mechanical laboratory.

Students' drawings.

A collection of the students' works was shown to the Commissioners, the drawing being extremely creditable, and showing that copying from examples is not encouraged, and that a considerable portion of the students' time is occupied in preparing designs and independent surveys.

The president stated, in answer to questions, that so far as he could judge, the new system of a mere qualifying examination brought them in a class of men, perhaps not quite so well prepared in the first instance, but that in the long run these men compared very favourably with those previously selected by competition.

Each student has a separate bedroom and study. These rooms occupy a special block of buildings.

The number of appointments offered annually by the Indian Government is not sufficient for the whole number of students who are now being educated at the college, and it is supposed that probably some 30 per cent. of the students will enter into private employment.

X.—Royal Naval College, Greenwich.

Royal Naval College, Greenwich.

We have been furnished with the following facts with respect to the course of instruction pursued in the Royal Naval College by students of marine engineering and naval architecture.

Course of study.

During the first session the study of mathematics, pure and applied, goes on in the mornings. In the afternoons professional subjects, practical physics, and practical chemistry are studied, and courses of lectures on physics and chemistry are given by college professors, between the morning and afternoon studies. The evenings are available for private study and for recreation. Saturday afternoons are also available for the same purposes during the whole of the session, and Wednesday afternoon during about half the session.

Course for assistant engineers.

The assistant engineers, who remain at the Royal Naval College for two additional years, and the students of naval architecture, have precisely the same instruction in all matters except such as are purely professional. Successful efforts have been made to give each set of students a broad view of the profession studied by the other set of students, by arranging suitable lectures for this purpose.

Subjects of instruction.

The morning work consists of the more advanced mathematics, solid geometry, theory of equations, differential equations, hydrodynamics, rigid dynamics, strength of materials and of structures, &c.

The afternoon work consists of more advanced professional instruction, relating to the design either of a ship or set of engines, all the calculations relating thereto, and the making of complete sets of drawings of all the parts, instead of being confined, as in the first year, to the mere elementary features of the profession.

The study of chemistry and physics takes place during the second and third years in the same manner as in the first, more advanced work being taken in hand as the knowledge of the students increases.

Private students.

The school has not been so successful in attracting private students, as was anticipated at first, although the total number being educated there now reaches a considerable figure, the naval architects standing at about 30 for foreign students, and 20 for

British students. Many of the British students, however, being engaged in private trade, leave at an early period of their studies, for the purpose of undertaking actual professional work. There have only been about 16 private students of marine engineering in the school, eight foreign and eight British.

Influence of Royal School of Naval Architecture on the mercantile marine.

The influence of the Royal School of Naval Architecture on the Mercantile Marine has, however, been more felt through Admiralty students leaving the Admiralty service, than by means of private students. The Admiralty students occupy much higher positions in private shipbuilding and engineering firms than private students of the school have been able to secure. The Mercantile Marine has gained in many ways by this introduction of professional men from the Admiralty service. These men have carried with them the high standard of workmanship, traditional in Her Majesty's service, as well as the knowledge necessary to apply principles to new conditions and circumstances.

Lloyd's Register of Shipping has many surveyors who have been students in the school.

Foreign students.

The foreign students for the most part, although not exclusively, have been sent by their own Governments, and on the completion of their training have been employed in the constructive offices in their several countries.

Course for naval officers.

Naval officers have a very extended course of instruction in marine engineering, both at sea and at the Royal Naval College. They are instructed when at sea by the chief engineer of the ship, and when in harbour by officers detailed for that purpose. This instruction is given to all officers up to and including the rank of captain, and in the case of the junior officers it is compulsory.

Course for sub-lieutenant, lieutenant, commander, and captain.

At the Royal Naval College, sub-lieutenants, lieutenants, commanders, and captains attend lectures on the steam engine, and have models of important parts available for illustration. The source of energy by burning coal in air is investigated, the most economical types of engines, causes of breakdown, inefficiency, &c. are explained; the duration of boilers, wear and tear of engines, most economical speed, &c. are all studied in detail.

Course of naval instruction.

The course in naval architecture is not so extended at present, and is not of such old standing as the course in marine engineering. Officers are instructed in the leading features of shipbuilding, the names and uses of the several parts, the construction of turrets, methods of ventilation, drawing, watertight sub-divisions, means of maintaining and preserving the hull in a state of efficiency, are dealt with in detail, and some officers have shown considerable aptitude in these studies. Officers are also taught the more elementary scientific proportions of naval architecture, viz., the construction of metacentric diagrams, how to find the centre of gravity of a ship either by calculations

or by experiment, how to calculate the stability of a ship, the arrangements of sail plans, &c.

At the present time there are nine Admiralty students at the Royal Naval College, undergoing a three years' course of instruction in naval architecture; six Admiralty students (assisting and acting assisting engineers, Royal Navy) undergoing a three years' course of instruction in marine engineering; and 39 Admiralty students of the same rank undergoing a nine months' course of instruction in marine engineering. Number of students.

In addition to the professional students of naval architecture and marine engineering, some of the naval officers receive instruction in naval architecture, and nearly all receive instruction in marine engineering at the Royal Naval College. The particulars are given below :—

	Number in the College.	Number attending.	
		Naval Architecture.	Marine Engineering.
Captains - -	6	5	5
Commanders - -	9	8	5
Lieutenants - -	17	1	10
Navigating lieutenants	3	2	3
Sub-lieutenants -	66	0	66

These numbers vary from year to year and even from month to month as appointments are made, especially in the case of the senior officers, but the above figures may be looked upon as fair average numbers.

XI.—Crystal Palace School of Practical Engineering.

This school, which we did not visit, is in two divisions, mechanical engineering and civil engineering, under the direction of Mr. J. W. Wilson. It professes to prepare students for taking articles under engineers, or in the case of those who are already articled, it provides systematic practical and scientific work. An aim also of the school is to give such practical instruction as may be valuable to colonists and explorers of new countries. Crystal Palace Engineering School.

In the mechanical engineering section, the age on admission must be not less than 16. There is a preliminary entrance examination, and for those unable to comply with its conditions, a preparatory course has been arranged. There are three terms of 15 weeks each. Hours 10 to 1 and 2 to 5 each day. One term is devoted to mechanical drawing, a second to pattern making, and a third to fitting and smiths' work. The mechanical course is comprised in one year. The fee for the year is 50 Mechanical engineering course.

guineas, and for additional terms 17*l.* 10*s.* each. Students can be received for a single term on payment of 25*l.*

Civil engineering course, Crystal Palace School.

The civil engineering course also extends over one year, and is designed as a preparation to articles. There is a preliminary examination to test the suitability of the student. The first term is devoted to projecting and the practical preparation by actual surveys and levelling of plans in detail, and plans and estimates for Parliament. The second term is devoted to the preparation of detailed section plans, estimates of the above work for the contractor, and the third term is utilized for original designing of girders, bridge work, &c., and the examination of important existing engineering works completed or in progress. The fees for this section are 60 guineas for the course, or 25 guineas for each single term.

Examination.

At the end of each term there is an examination by engineers of eminence, not connected with the school, and certificates are given for proficiency in lecture subjects and work in the drawing office and shops. A colonial section, for the practical and theoretical instruction of intending colonists, has also been arranged.

XII.—Oxford.

Oxford University Museum.

The Commissioners met at the University Museum, where they were received by the Curator, Professor H. J. S. Smith, F.R.S., (whose untimely death, shortly afterwards, Science has had to deplore), Professor Moseley, F.R.S., Professor Westwood, and Dr. Acland, F.R.S. The history of the foundation of the museum was explained to the Commissioners by Dr. Acland, who pointed out the principles on which the building was constructed, and upon which the various departments of zoology, comparative anatomy, and geology have been arranged, thanks especially to the zeal and ability of the late Professor Rolleston. Students of science, who, however, are not numerous, make much use of the museum for study, and can attend the lectures delivered by the several professors in the rooms attached to the museum, or work in the zoological and physiological laboratories. A new set of laboratories is about to be built for Professor Burdon Sanderson, F.R.S., in proximity to the museum, which is itself so planned as to enable extensions to be made at any time. The extensive entomological collections under the care of Professor Westwood are also housed in the museum, and the herbarium of the late Dr. Daubeny will shortly be included amongst the museum collections. Valuable features of this institution are the Radcliffe and Ashmolean Scientific Libraries, containing more than 50,000 works of reference, and a large and complete lending library of scientific text books and periodicals.

Clarendon Laboratory.

Attached to the museum are the departments of physics and chemistry. The former of these is contained in a separate

building adjoining the museum. The Clarendon Physical Laboratory, under the direction of Professor Clifton, F.R.S., the professor of experimental physics, is one of the most complete in this country, and was built at a cost of about 12,000*l*. It contains a series of rooms clustered round a central hall, fitted with glass cases for the storage of apparatus, and a roomy and well arranged lecture theatre, together with workshops and other necessary adjuncts. The several rooms set apart for the students' work are designed with special reference to the branch of physics which the student desires to pursue; thus, certain rooms are occupied by optical apparatus, and are used solely for experiments on light, others are fitted with the necessary arrangements for experiments on heat, and so on. The professor only admits to these practical courses, such graduates or undergraduates as have sufficient mathematical knowledge to benefit from his advanced teaching, and as are capable of handling with the requisite care the expensive and delicate apparatus with which they have to work. The large amount of personal attention which the professor and the university demonstrator are obliged to give to each student working in this laboratory, prevents the classes from being numerous; about twelve students work at optics, and about eight or ten at heat. Physics at Oxford.

The Chemical Laboratories under the direction of Professor Odling, F.R.S., have been enlarged since the museum was built, by 64 places, and now give accommodation for 88 students. The number working at the time of the Commissioners' visit was 51. In addition to the University laboratory, Christchurch has a special chemical laboratory under Mr. Vernon Harcourt, F.R.S., and Balliol a smaller one under Mr. Dixon, whilst inter-collegiate lectures on the various science subjects are given to supplement those of the University professors. Magdalen College has also instituted a physiological and chemical laboratory. Chemical laboratories.

The arrangements and facilities for the study of medicine and the preliminary science subjects are not so advanced at present at Oxford as at Cambridge; the appointment of Dr. Sanderson as the Linacre Professor of Physiology will, it is expected, greatly promote the study of medical science in the University. Physiology.

The Art Galleries and Schools of Art form an important feature in the educational establishments of Oxford. Professor Ruskin's school is chiefly devoted to landscape and water-colour drawing, and is open to undergraduates and others. A valuable collection of works by Turner and other masters has been presented to the University by Mr. Ruskin, and is much used for copying. Oxford art galleries and schools of art.

The Government Art School is situated in the basement of the Art Galleries, and is insufficiently accommodated. It is attended by from 50 to 60 students, mostly young, none of whom carry on designing or advanced work.

XIII.—CAMBRIDGE.

Cambridge science teaching.

The Commissioners were informed, that previous to the year 1871, no practical teaching of science was carried on in the University, with the exception of chemistry. In that year, the late Professor Maxwell was appointed professor of physics, and designed the Cavendish physical laboratory presented to the University by the Chancellor, the Duke of Devonshire; and Professor Michael Foster was elected as lecturer on physiology in Trinity College. From the above year, up to the present time, science teaching in almost every branch has been instituted, of at once the most advanced and the most practical character.

Maxwell's influence on the examination system of the university, by introducing physical problems in addition to the more purely mathematical subjects formerly in vogue, has been of the highest importance; and that of Professor Foster equally so in another direction, viz., that of encouraging and developing the teaching of the biological sciences, as forming an important part of the scientific training for the profession of medicine. Other eminent Cambridge men, Lord Rayleigh, Professors Stokes, Humphreys, Liveing, Dewar, Vines, Mr. Coutts-Trotter, and the late Professor Balfour among the number, have done much to assist in this matter; and there is no doubt that the authorities of the University generally, are at the present time fully alive to the importance of these practical scientific studies, and are determined to push forward and co-ordinate the still somewhat unsystematic efforts which are being made by the different colleges in this direction. The energy and activity which is thus being displayed at Cambridge is very remarkable.

Scientific institutions and laboratories.

Of the various scientific institutions and laboratories now existing at Cambridge, the most important are: (1) the Cavendish Physical Laboratory under Professor Lord Rayleigh; (2) the Physiological and Morphological Laboratories, under Professor Foster and Mr. Sedgwick; (3) the Chemical Department under Professors Liveing and Dewar; (4) the Geological Museum under Professor Hughes; (5) the Mineralogical Collection (Professor Lewis); (6) the Mechanical Workshops of Professor James Stuart; (7) the Fitzwilliam Museum; besides (8) the purely professional departments of medicine under Professor Humphreys and others.

The Cavendish Laboratory.

(1.) *The Cavendish Laboratory.*—This laboratory, which is one of the most complete of its kind, was designed by Professor Clerk Maxwell, and since his death the direction has devolved upon Lord Rayleigh. There are special rooms for optical research, for exact measurements of different kinds, and for special physical research in all its branches. The Professor is assisted by two demonstrators, Messrs. Glazebrook and Shaw, who undertake the elementary instruction of about 45 students, carrying on a specific course of practical work. The demand for this tuition is steadily increasing, the attendance having trebled in the last three years. The fee for working in the laboratory is two guineas per term. There is no endowment in

connection with the department, but a fund amounting to 2,000*l.* has been raised at the instigation of Lord Rayleigh, for the purchase of apparatus. The senior students attend lectures on advanced electricity, given by Lord Rayleigh, who is himself engaged in original physical research, and great stimulus is thus given to the higher work of the students, who assist him.

Biological department at Cambridge.

(2.) The *Biological Department* at Cambridge has grown from very small beginnings in 1871 to a very complete and extensive department at the present time, in buildings specially arranged for the purpose. In the physiological laboratories, 120 students are at present receiving instruction under Professor Foster, assisted by two demonstrators, whilst no less than 80 students are studying morphology in separate laboratories, (designed by the late Professor Balfour), under Mr. Adam Sedgwick. Most of the students are preparing for the medical profession; the total number of the medical students of the three years now at Cambridge amounting to 200. Ladies from Girton and Newnham also attend these laboratories. The cost of these buildings was about 11,000*l.*, and a considerable sum for the maintenance of the department will be set apart, under the new University scheme, from the funds of the various colleges. In connection with this department is a valuable museum of comparative anatomy, under Professor Macalister, and a herbarium and botanical laboratory, recently arranged by Professor Vines.

Cambridge chemical department.

(3.) *Chemical Department.*—This department, so far as buildings and accommodation are concerned, is very insufficient. A sum of 30,000*l.* has, however, lately been voted for building a complete set of chemical laboratories and lecture rooms. There are about 185 students of chemistry in the University, of whom about one-third are medical students. The fee for attending the chemical laboratory is two guineas per term, with an additional 17*s.* for apparatus.

Owing to a change which has recently taken place in the statutes, students taking the mathematical degrees are allowed to study natural science in the latter part of their course. Few students have time or inclination for original research.

Woodwardian geological museum.

(4.) *Geological Museum.*—This consists of the renowned Woodwardian Museum of Geology and of a large number of collections illustrative of economic geology. The museum has been raised to its present position by the labours of the late Prof. Sedgwick, to whom the existing museum buildings, commenced in 1835, owe their origin. These valuable collections are employed by Prof. T. McK. Hughes in his lectures. A detailed description of the collection, and of the technical courses which the Professor would wish to see established in Cambridge, will be found in the Appendix, Vol. IV.

Mineralogical collection.

(5.) The mineralogical collection at Cambridge is one of great value and completeness, having been chiefly formed by the late Prof. W. H. Miller. The department is now under the charge of Prof. Lewis.

Mechanical workshops of Prof. Stuart, Cambridge University.

(6.) *The Mechanical Workshops of Professor Stuart.*—An interesting feature of the present scientific activity at Cambridge is the experiment inaugurated by Prof. Stuart about five years ago, by the establishment of a department for carrying on practical work in machine construction. Prof. Stuart's intention in establishing this department is to enable the sons of manufacturers and others who are sent to the University, to obtain instruction of a kind likely to be of immediate practical value in their subsequent calling. On inspecting the workshops, which are still unfinished and in gradual course of erection, the Commissioners were impressed with the bonâ fide character of the work. The department contains a fitting shop, smithy, a small erecting shop, and a draughtsman's office, together with a cupola and casting shed. About 42 students were working at the time of the visit. All the men go through a regularly prescribed course of work, special attention being paid to the instruction in mechanical and machine drawing, which is made the foundation of all the teaching in the shops. The system of tuition is arranged on the basis of an actual mercantile establishment. The rate of wages for each student is fixed, the cost of material and the time employed being accurately noted and entered in a ledger, so that the cost of every article produced can be ascertained. An examination of the register of attendance showed that 20 students had in eight weeks attended 725 times and worked 2,121 hours, giving an average of 4½ attendances of 3 hours' duration per student per week. For the purpose of instructing the students, five or six skilled mechanics are employed, who are paid the average wages of their class. Of these, two are former students of the University, who, having gone through the course, remain as paid workmen. The work in progress during the Commissioners' visit was of a most diverse kind; some of the most advanced students were constructing dynamo-machines, steam engines, telegraphic and electrical apparatus, &c.

On inquiring as to the previous training of men coming to the University from public schools, and attending his workshops, Prof. Stuart informed the Commissioners that only on one occasion had he found a man who had any knowledge of linear drawing.

Prof. Stuart's opinion on the value of mechanical laboratories.

In conversation with the Commissioners, on being asked whether he considered that practical instruction in a factory could to any extent be replaced by theoretical work and laboratory instruction, Professor Stuart said, "Certainly not." He would attach the theoretical work to be done in the evening, to the practical work they were doing in the daytime in the regular workshops. If he could work out his plan thoroughly in a large manufacturing town, such, for instance, as Manchester, he believed that engineers and large employers would after a time admit that it would be an advantage to them to have such a shop as his in the town. At the present time the pupils or apprentices are either working by themselves or they are not. If by themselves, they are at some rough work; if they are not,

practical men have to be paid to look after them. But in most shops you would be told, "All we can do is to take young men, to pick up at best what they can." He would be happy in such a shop to take the young engineer when he could be spared from his other work, in the summer time or at night. If the employer had thorough confidence in the instruction he was able to give, he would offer premium prizes to the best apprentices, and let them pay off their indenture fees by means of prizes gained at the technical school. By that means it would be possible to create a most useful class of foremen. He thought it would not do to send a young man to be trained as a foreman in a college, after he had been three or four years at the works. If he were called upon to manage a large engineering concern, one of the earliest things he would do would be to get a thoroughly good man to give night school instruction in pure science and mathematics to the most promising apprentices, and he would give lads the right of having three or four hours daily of such instruction in the daytime. He thought that good steady lads would profit by this teaching so much that he should be more than repaid its cost.

Fitzwilliam Museum.

(7.) The Commissioners visited the Fitzwilliam Museum, under the guidance of Dr. Porter, the Vice-Chancellor of the University, and Prof. Sidney Colvin, the Slade Professor of Art. The collections in the museum consist of ancient and modern pictures, antiquities, casts from the antique, and a very fine collection of wood engravings, and prints from the early masters, and an art library. The students of the University are allowed to copy the pictures exhibited in the galleries, and the library is open daily to students, of whom some few are undergraduates. Prof. Colvin lectures on various subjects connected with the history of art, and finds his lectures well attended; but there is no practical instruction in drawing or painting given at Cambridge, as is the case with the Slade schools of London and Oxford.

College laboratories.

In addition to the above-mentioned scientific institutions immediately connected with the University, there are at Cambridge not a few laboratories and museums attached to the various colleges; thus, for example, in Caius College, which is essentially a medical college, there are 50 men at the present time studying practical chemistry in a small and very inadequate laboratory, containing working room for 22 men, under Mr. Pattison Muir. There is another small laboratory in St. John's College. In addition to lectures given by Profs. Liveing and Dewar, special courses on chemistry are given in the various colleges by Messrs. Muir, Main, Hicks, and Lewis.

Cambridge Scientific Instrument Company.

The Cambridge Scientific Instrument Co.—As another illustration of the scientific activity at Cambridge, this institution must be mentioned. It was founded by two university men, Messrs. Dew-Smith and Horace Darwin, for the purpose of the manufacture and sale of scientific instruments of the highest and most delicate character. The necessity for those engaged in

scientific work, of the existence in their neighbourhood of scientific instrument makers, has long been acknowledged by the German universities, where a university mechanic is always to be found. To supply this want, the above gentlemen undertook the establishment of the business. The instruments made are especially for delicate physiological research, and others requiring great precision. The scientific knowledge and skill of the promoters enables them not only to make all the well known instruments required by men of science, but also to design and construct new apparatus for special purposes.

General opinion at Cambridge as to science instruction.

In conversation with the University Professors on the subject of scientific instruction, the Commissioners were told that the great drawback at present in Cambridge is the want of co-ordination of the different scientific studies. This, however, thanks chiefly to the efforts of Mr. Coutts-Trotter, of Trinity College, is gradually being remedied, so that a student coming up to Cambridge, and desirous of adopting a scientific career, will in future have equal facilities with one who goes in for purely classical or mathematical studies. The tendency has hitherto been to make a man feel that a liberal education must necessarily conduct him to the Church or to the Bar. The college tutors, whose business it is to advise the freshman, and inform him of how he is to get his teaching, have, as a rule, been ignorant of science, and even of the facilities which Cambridge possesses for carrying on a scientific education; moreover, the science Professors have more or less been free lances, each doing the best he could for his own subject. It is intended that the system of intercollegiate lectures shall bring the subjects chosen by the several Professors into co-ordination.

Prof. Foster's opinion.

Respecting the method of teaching science, Prof. Foster expressed his opinion that the first duty of a good Professor was to create men who should carry his own work further, and that the highest work of the head of a department is the education of a few good men who are to be equal to himself. His plan was, therefore, to train up his demonstrators so that they could take the advanced men. He believes that so far as the students are concerned, the Professor should take the elementary lecture classes, leaving the advanced lectures to the men he had trained.

XIV.—MANCHESTER.

Elementary instruction of the Manchester School Board.

The Commissioners inspected many of the schools under the direction of the School Board of the city of Manchester. The average attendance in this city for the quarter ending September 1883, was, voluntary schools, 25,736, and board schools, 19,992, or 1 in every 7·5 of the population, and the cost to the rate-payers during the last five years has been 2*d.* in the £. Statistics

of the School Board and particulars of the visits paid to the schools will be found in the Appendix, Vol. IV.

Manchester higher elementary schools.

The points of special interest as regards Technical Instruction are (1) the foundation by the Board of so-called graded schools, or higher elementary schools, into which the more advanced or most talented children from the primary school can be drafted, and where the higher subjects, especially science and drawing, are taught more satisfactorily and more economically than can be done in a school containing children of all ages and of all stages of progress; (2) the establishment by the Board of a systematic series of Science and Art evening classes, as well as of evening schools for providing instruction in reading, writing, and arithmetic, for those who have had no opportunity of learning when young; (3) the establishment of classes for instruction in the use of tools, in two of the Manchester Board Schools.

Science teaching and evening classes, under School Board.

Manual work.

Central school.

Of the higher elementary schools two may serve as examples. The first and most remarkable of these is the Central School in Peter Street, taken over by the Board in 1880, and now transferred to new and most complete premises in Deansgate. The results of the science teaching in this school are well worthy of notice. Out of a total of 320 boys, 276 have passed Standard VI., and are taught during the day, mathematics, physiology, chemistry (both practical and theoretical), sound, light and heat, magnetism and electricity, physical geography, and mechanics. French, too, is taught throughout the school. A girls' higher elementary school forms one-half of the building; of the scholars of which 93 are above Standard VI.

During the past year the following science classes have been formed, and in May 1884 the pupils will be examined :—

Mathematics, Stage II.,	A.	34
„ „ I.	B.	49
	C.	43
	D.	95
Physiology, elementary stage, and Hygiene		62 each
Chemistry, practical, class	A., advanced	40
„ „ „	A., elementary	25
„ „ „	B. „	55
„ „ „	C. and D. „	80
„ theoretical, class	A., advanced	32
„ „ „	A., elementary	40
„ „ „	B. „	41
„ „ „	C. and D. „	96
Sound, light, and heat, class	A., advanced	26
„ „ „	A., elementary	26
„ „ „	B. „	42
Magnetism and Electricity, class	A., advanced	43
„ „ „	A., elementary	16
„ „ „	B. „	46
„ „ „	C. and D. „	107

Physiography, advanced	10
Theoretical Mechanics	12
Practical Organic Chemistry, advanced	11
" " " elementary	14
Theoretical " " advanced	11
" " " elementary	14

Manchester Central School.

The following are the results of the examination held by the Science and Art Department in May 1883:—

Results of science examinations.

	Advanced.		Elementary.	
	1st Class.	2nd Class.	1st Class.	2nd Class.
Mathematics	9	10	2	40
Physiology	—	6	—	—
Practical Inorganic Chemistry	7	9	29	42
Theoretical Inorganic Chemistry	8	10	23	40
Acoustics, Light, and Heat	4	8	4	63
Magnetism and Electricity	2	11	35	79
Physiography	—	—	7	2
Theoretical Mechanics	—	—	8	2
Practical Organic Chemistry	—	—	11	8
Theoretical Organic Chemistry	—	—	17	2
	2nd Grade.		1st Grade.	
	E.	G.	E.	G.
Freehand Drawing	—	6	21	69
Geometrical Drawing	—	1	14	34
Model Drawing	1	6	6	34
Perspective Drawing	1	2	—	—
Drawing to Scale	—	—	5	13

Practical chemistry.

The total grant from the Science and Art Department earned by this school in 1882–3 was 398*l*. Practical Chemistry is extremely well taught; no less than 163 boys, of whom 28 are advanced pupils, were engaged in laboratory work in the winter 1883–4, as well as 20 girls, and the new school buildings in Deansgate contain a laboratory well fitted and arranged for 70 boys working at once, with a lecture room attached seating 100. Every boy in the school learns drawing upon the South Kensington method.

Scholarships.

To the boys' school is attached one for 200 girls, and 20 scholarships exist for necessitous boys and girls from the primary schools. These are of the greatest service as they form the first step in the ladder by which a talented boy may climb from the board school to the University. Other scholarships take the boy from this higher elementary to the Manchester Grammar School, and others again from that to the University. Several boys have already accomplished this feat.

The other higher elementary school visited is that in Ducie Avenue. This is a new school containing 900 children in four departments; it cost, with land, fittings, and chemical laboratory, about 11,000*l.* The upper school fee is 9*d.* per week, the lower 6*d.* and 4*d.* Both boys and girls are taught science, and both (viz., 69 boys and 46 girls) work in the chemical laboratory, which is in a separate building, well lighted and ventilated, and having a special class-room attached; of the boys 136 are in Standards VI. and VII., or above, and of the girls 96. The grants earned by this school from the Science and Art Department were 112*l.*; and this, together with the school pence, more than cover its working expenses. Ducie Avenue school, Manchester.

These two schools may be taken as an example of what can be accomplished by the School Board in a large city, even with as low a rate as 2*d.* in the pound; and although in appliances of certain kinds these schools are less completely furnished than many Continental schools, your Commissioners have seen none which surpassed them in general efficiency, or in the tuition of any special subject, except in that of drawing. The Appendix contains further details of these schools.

In addition to the day schools, the Board each winter conducts elementary evening schools, for providing instruction in reading, writing, and arithmetic, for such persons as had not the opportunity of learning when young. Board school evening classes.

In the year of our visit, 1882, the Board opened 19 such schools (32 separate departments), and in the second week of the session no less than 2,690 pupils were present.

The schools meet on three evenings per week, for two hours.

In 1878–79, 37 per cent. of the pupils in attendance were in the Upper Standards.

„ 1880 70 per cent. were examined by Her Majesty's Inspector, in the Upper Standards.

In addition to the above, the Board have also Science and Art and other classes as follows:—

Science and Art	117 classes.
French	14 „
German	5 „
Latin	2 „
Spanish	2 „
Shorthand	5 „
Singing	6 „

The number of pupils at the above classes for the winter season 1881–82 is shown by the following table:—

Science and Art classes under the Manchester School Board.

TOTAL NUMBER of PUPILS attending the SCIENCE AND ART CLASSES conducted by the Board, 1881–82.

No. of Subject.	Subject.	No. of Pupils.
I.	Geometry	113
II.	Machine construction	87
III.	Building construction	61
V.	Mathematics	640
VI.	Mechanics—Theoretical	17
VII.	„ Applied	27
VIII.	Acoustics	472
IX.	Magnetism and electricity	589
X.	Chemistry, inorganic	509
X*p*.	„ „ practical	189
XI.	„ organic	32
XI*p*.	„ „ practical	14
XIV.	Physiology	384
XV.	Botany	47
XVI. and XVII.	Biology	10
XXII.	Steam	20
XXIII.	Physiography	81
XXIV.	Agriculture	25
	Drawing, 2nd grade	392
	„ 3rd „	37
	„ teachers	76
	Total	3,822

Attendance at other subjects taught in the Board school evening classes were:—

Subject.	No. of Pupils.
French	229
German	43
Latin	29
Spanish	33
Shorthand	220
Singing	254

Handicraft work in Manchester Board schools.

Exercises in the use of tools have been introduced into two schools with marked success. The work is superintended by the School Board carpenter, and the boys are eager to attend the instruction, which is given before and during the usual school hours. The rooms in which the work is carried on are distinct from the schools proper, and are furnished with joiners' benches, of the French type, costing 1*l*. 2*s*. each, at which two boys work, the cost of the set of tools for each boy being 1*l*. 2*s*. 5*d*.

Each school is also provided with one lathe, procured from La Villette, at Paris, at the cost of 6*l*. There are 24 boys engaged in the one school, and 18 in the other. The Manchester School Board has undertaken this work experimentally, and has not as yet entered it in the time-table; but an entry has been made in the log-book indicating this deviation, and Her Majesty's Inspector has not raised any objection. The boys

work 1½ hours per day at each school. The carpenter's wages are 2*l.* 2*s.* per week, and he devotes about half his time to the instruction.

The school also contains a large collection of models and other illustrations bought in Paris by the Board. We were pleased to find that this action of the Manchester School Board, taken in consequence of the recommendations made in our First Report, is appreciated, and likely to be followed by others. Of the advantages of such a training in manual work there can be no doubt.

Messrs. Mather and Platt's workshop school, Salford.

Messrs. Mather and Platt's Workshop School.—This is a private technical evening school, established and supported by the firm for the benefit of their apprentices.

Under the guidance of Mr. Mather, we inspected the school room and examined specimens of the students' drawings.

Mr. Mather stated that there are 68 scholars in the school, which is designed to provide science teaching for the apprentices employed in the works. No strangers are admitted for instruction. The drawings are of work actually in progress in the works. The teacher lectures upon them, and explains and makes calculations, and the boys the next day at the works see the very thing they have heard about here. They are allowed to go through the shop in all directions with the teacher from time to time. Everything required (patterns and models) is brought here full size. The great feature is that in the workshop they have the actual things being made under their own observation, and which have to be sold. The parts upon which they are working here in detail, they afterwards see made up as a whole.

Advantage of workshop schools.

In Mr. Mather's opinion, you must bring the school to the workshop; you cannot bring the workshop to the school. Bringing the school to the workshop is simple and inexpensive. The teachers here are draughtsmen in the works, and by this teaching they add to their ordinary income. The teacher explained that the boys are not allowed to copy drawings; everything is drawn to a different scale from the flat copy, or the pupils have to draw from actual patterns or pieces of machinery used in the shops. Interesting details with respect to this school are found in the Appendix.

Mr. Mather pointed out that the advantage of the teachers being persons employed in the works, and being trained in this school, rather than in science classes, is that he knows what each person is working at every day, and has the opportunity of pointing out something connected with the work he is doing. The teaching has an actual bearing on his every day work. The students are rewarded not only for proficiency in drawing, but for regular attendance, and actual proficiency in their manual work. It is also a condition of employment that they should be regular in their attendance here.

Mr. Mather's opinions

In reply to the question as to the advantage which the works have derived from the establishment of these schools, Mr. Mather

on technical instruction of artizans.

replied:—"An incalculable advantage. We desire to send out "abroad yearly one, two, or more, thoroughly competent men, "who shall not be simply mechanics in the ordinary sense of "the word, but who shall be able to turn their attention to "anything coming under their notice, whether they have done "the thing before, or not (they are sent out simply as mechanics). "We had the greatest difficulty in finding such men, until we "began to take them from this school, and since the school has "been established we have been able to send boys at 20 to 21 "to long distances from England, and to place in their hands "work which they have not had much to do with before, and "by their own intelligence they have made competent teachers "of others, and given the greatest satisfaction. Thus one was "sent out only a few years ago not quite out of his apprenticeship, "and is now getting 4*l.* per week."

Again, he stated that most of his mechanics are members of the Amalgamated Society of Engineers, and this society not only shows no jealousy in any way of the systems adopted, either of tuition or of giving early employment to boys when they are fit for putting on good jobs; but, on the contrary, they seem to like it, and are pleased at the lads' progress; and he can say the same with respect to the trades generally that are employed in the works.

In reply to the question whether the foremen had any jealousy of the teacher, Mr. Jones, the teacher, replied,—"There is no "jealousy whatever. They are always ready to give me assistance "as a teacher."

Mr. Mather is not aware of any other works in the neighbourhood of Manchester, or even in Lancashire, where this teaching method is adopted.

The manager of Messrs. Mather and Platt's works remarked, as regards the influence of the school upon the workshop:—"Instead of requiring draughtsmen to look after every separate "job, the young fellows who are growing up now can make "their own drawings, work to them, and fit the work together "and erect it, where it used to require a separate man for each "department. The men are most intelligent, and understand, "and can execute, their work much better and at a much earlier "age. We form thus our own foremen from the boys who have "been in the school. We do not find any dissatisfaction or "awkwardness with the trade union."

Manchester Building Trades Institute.

Manchester and Salford Building Trades' Institute for Technical Education.—The evening classes of this Institute were inspected by the Commissioners.

The following is a concise statement of the rise and progress of the Institute, made by Mr. Parnell (for further details, *see* Appendix):—

"During the year 1867 Professor Jevons brought forward the Scheme of Technical Education and laid it before the various trades of this country.

"It was taken up by the Amalgamated Society of Carpenters and Joiners of Great Britain, and in various towns there was a strong movement made to inaugurate classes for teaching the technical portion in connection with the various branches of the building trade. Manchester Building Trades' Institute.

"In February 1868 the Executive Council of the Society decided to lend small sums of money to members, in localities where a class could be commenced with a probability of success.

"In October 1869 the Institute became affiliated to the Lancashire and Cheshire Union of Institutes, which led to the classes being placed under the inspection of the Science and Art Department at South Kensington.

"The students of this Institute have been four times successful in winning the special prize for building construction, given in connection with the Union of Institutes (viz., three first-class Advanced and one first-class Elementary).

"The number of students who have joined the classes in each year are as follows:—

1868–69	200	1875–76	76
1869–70	100	1876–77	89
1870–71	80	1877–78	69
1871–72	82	1878–79	59
1872–73	88	1879–80	79
1873–74	107	1880–81	35
1874–75	84	1881–82	40

"The number of those who have remained in the classes the whole of the session and were examined, has been on an average one-third of those who have entered the class each session. Among many causes operating to effect this diminution of numbers is the uncertain state of the building trade at Christmas and New Year; it is also found that the interest in the class work diminishes after the first three months, many do not like to start at the bottom of the ladder and climb steadily up. The name of "examination" as the time draws nigh, also frightens others. This class draws all its members from the building trade solely, among which many are young men from country villages, whose education has until recently been of a very poor kind, many not being able to spell or write properly, so that it will be seen that it is a heavy up-hill task that this Institute has been doing with the limited amount of means at hand.

"For the first six years the Master Builders' Association gave an annual subscription of 10*l.*, which they then discontinued. Several other gentlemen gave a guinea a year for the first four years. The Manchester Society of Architects have come forward and given prizes to be competed for yearly, since the first year of its commencement. Other gentlemen have done likewise, but have dropped off one by one, and now the Society of Architects as a body, and two individual members, alone are donors of prizes.

"This Institute was the first in this district to take up technical education in its entirety, by having a teacher who was practically and theoretically qualified to teach the subject of building construction. There have been a large number of students passed from this Institute who have taken up positions as foremen and clerks of works, and even become master builders."

It is thought that the master builders have not sufficiently encouraged these classes by advising their apprentices to attend them; an opinion was expressed that such attendance ought to be made obligatory on all apprentices.

Manchester Technical School.

Manchester Technical School.—In the beginning of 1882 definite efforts were made with the view of utilising the Manchester Mechanics' Institution exclusively as a technical school, the instruction in which should be especially adapted to the needs of the local industries.

On the 28th July 1882, a meeting of gentlemen interested in the subject was held at the house of Mr. Oliver Heywood, at which Mr. Philip Magnus, the Director and Secretary of the City and Guilds of London Institute, was present, and announced that the Institute was willing to give a donation of 100*l.* and a contribution of 200*l.* a year for three years in support of a suitably equipped technical school. The meeting cordially approved the idea of adapting the Mechanics' Institution to the purposes of technical instruction. Subsequent meetings were held, and on the 27th December 1882 the Manchester Mechanics' Institution passed from the control of its former directors into the hands of a new council composed of representatives of the Corporations and School Boards of Manchester and Salford, the Victoria University, the Owens College, the Manchester Chamber of Commerce, the School of Art, the City and Guilds of London Institute, together with gentlemen prominently engaged in the chief staple industries of the district.

The classes for the session 1882–83 being already in active work, the new Council was chiefly engaged during the spring and summer in making the extensive structural alterations required to carry out their plans; in the preparation of a syllabus, the selection of a suitable teaching staff, and in raising subscriptions.

Description of the school.

During the summer the large room on the ground floor was fitted up as a mechanical engineering workshop, and supplied with 3½-H.P. "Otto" gas engine, a 6-inch centre lathe, a 6″ by 8″ slotting machine, one drilling machine, a grindstone, 12 vice benches, Whitworth screwing tackle, gauges and surface plates, and with other needful appliances. On the same floor a large room has been fitted up as a technical museum, in which there is now placed a collection of large-sized building construction models designed and made by the teacher, numerous examples of building timbers, stones and marbles, samples of all kinds of plumbers' joints, perfect and defective, dye-stuffs, &c. The

school contains three laboratories, (1.) for pure chemistry; (2.) for metallurgy, with nine wind furnaces; (3.) for dyeing, bleaching, and printing; together having accommodation for upwards of 80 students. Extensive alterations have been made in the lecture hall, which has been furnished and lighted for the purposes of instruction in elementary drawing and design, for which it is admirably suited. On the upper floor a large room has been furnished exclusively for mechanical drawing. The walls are fitted with glass cases which contain numerous examples illustrative of mechanical and geometrical drawing. The room is specially lighted, and has bench accommodation for 90 students, who may either sit or stand. All drawing boards, T-squares, and paper, are provided gratis by the school. On this floor are two well arranged lecture rooms with rising seats, each affording accommodation for 100 students. In addition, the building contains numerous class rooms of the ordinary type. One of the large rooms is about to be fitted with a system of cotton spinning machinery of the value of 617*l.*, given by Messrs. Dobson and Barlow of Bolton. For the department of weaving and design, as applied to the goods manufactured in this district, five looms (three given by Messrs. Atherton of Preston and two by Messrs. John Dugdale of Blackburn) are being made, together with other appliances for the full practical illustration of the subject. **Manchester Technical School.**

The syllabus of the school embraces a boys' day school, in which instruction in science is one of the most important features; special day courses in science and technology; evening commercial classes, Science and Art classes under the Science and Art Department, technological classes under the City and Guilds of London Institute, and other independent technological classes; in all about 70 in number. **Syllabus of classes.**

The fees in the boys' day school (in which there are 90 pupils) are 2*l.* per term, which includes lessons in practical joinery and practical chemistry, and various science subjects. The fees in the evening science classes vary from 2*s.* 6*d.* per session of two terms for ordinary subjects of science to 10*s.* (with all re-agents and apparatus provided) in practical chemistry. **Fees.**

The teaching staff consists of 32 teachers whose salaries (all being paid fixed sums varying from 5*l.* to 250*l.* per annum, with no share in Government grant or fees) amount to about 1,800*l.* The total number of individual evening students is about 1,200. There are 140 students in the machine-drawing classes, 160 in the classes for geometry, 69 in building construction, 80 in chemistry, 40 in practical joinery, 40 in letterpress printing, 30 in telegraphy, 24 in electrical instrument making, 90 in mathematics, 36 in bleaching, dyeing, and printing, 61 in cotton manufacture and weaving and design, 111 in drawing and design, 36 in carriage building, &c. The total subscriptions and donations now reach 7,910*l.* 2*s.*, being 1,801*l.* in donations and upwards of 2,000*l.* per annum for three years. The fe **Teaching staff.**

received from students from September 30 to December 31 were about 700*l.*

The school was formally opened for the session 1883–84 on Thursday, September 27th, by the Chairman of this Commission. At the meeting the prizes, exhibitions, and scholarships, gained by the students of the old Mechanics' Institution in the session 1882–83, were given. The following summary is interesting as showing the extent to which the Institution was already successfully achieving the objects of technological instruction.

Award of scholarships.

The examinations in connection with the session of 1882–83, which were held in May last, resulted as follows:—

Two Whitworth Scholarships, each of the value of 100*l.*

One Whitworth Scholarship, of the value of 100*l.*, to the Local Exhibitioner at Dublin Royal College of Science.

One Royal Exhibition, value 50*l.* per annum, for three years, with free tuition.

One Royal Scholarship, for two years, value 50*l.* per annum, with free tuition, to the Local Exhibitioner at Dublin Royal College of Science.

Three Free Studentships offered, each for three years, at th Royal School of Mines, London.

The "Roscoe" Scholarship of 10*l.* per annum, for three years, at the Owens College.

The "Thomasson" Scholarship of 10*l.* per annum, for three years, at the Owens College.

The "Mather" Scholarship of 10*l.* per annum, for two years, at the Owens College.

An Evening Exhibition of the Union of Lancashire and Cheshire Institutes, in dyeing, bleaching, and printing, of 2*l.* 10*s.* per annum, for two years.

Three First Prizes in drawing and design, from the Union of Lancashire and Cheshire Institutes.

Two silver and two bronze medals of the City and Guilds of London Institute; and 15*l.* in prizes.

Two bronze medals of the Science and Art Department.

156 Queen's Science and Art Prizes.

425 Science and Art Certificates.

65 Technological Certificates.

139 Commercial Certificates.

The Allan and Newton (Amalgamated Society of Engineers) Memorial Prize of 5*l.* 12*s.* 8*d.* in books.

Manchester Grammar School.

Manchester Grammar School.—This is one of the largest and most efficient and flourishing of the modernized grammar schools existing in the country. It was founded in 1515, but placed on a new footing in 1867. The number of boys is now over 900, and more than 80,000*l.* has been spent on enlarged and most complete buildings, containing spacious gymnasium, class rooms, lecture theatre, drawing hall, library, dining rooms, and an admirably fitted chemical laboratory under the direction of Mr. F. Jones,

F.C.S. The modern and science sides of the school have been developed within the last 10 years, and are becoming more and more popular with the parents. The science teaching is always combined with a training in languages, either ancient or modern. The school has been most successful in obtaining a large number of Advanced and Honours science passes under the Science and Art Department, and has won the greater distinction of carrying off many University exhibitions and scholarships in science (to the success in classics we do not here refer). All the boys learn drawing. We had the advantage of a conversation with Mr. Dill, M.A., the High Master (*see* Appendix), who informed us that the boys coming up with scholarships from the Board schools, compared very favourably with the other scholars. Several of them have passed on to Oxford; of these three had gained University scholarships, and two had taken first classes in the final schools, their parents being in a humble position in life. Manchester Grammar School.

Two hundred and fifty of the boys are free or foundation scholars, the rest pay 12 guineas per annum.

The drawing school is open in the evening, and attended by from 100 to 120 students, who are chiefly artizans, and of these about 90 per cent. are qualified to earn a Government grant (*see* Appendix).

The Owens College, Victoria University.—The Owens College was established as a private trust in 1851, by a bequest of 100,000*l.* from John Owens, merchant, of Manchester, to found a college in which "the subjects usually taught at the English Universities" shall be professed. This private trust was reconstituted, and the college incorporated by Act of Parliament in 1871, and large additions to the funds of the college have accrued by donation and bequest. The Owens College. Victoria University.

The Victoria University, with its seat in the city of Manchester, and with Owens College as its single college at present, was founded by Royal Charters in 1880 and 1882. The Victoria University stands to Owens College, and the other colleges, which, at a future time, may be incorporated, in the same position as the Universities of Oxford and Cambridge stand to the colleges in those Universities. It is therefore not a mere examining board like the University of London, but a teaching university, as only those students can be admitted to degrees in science, arts, or medicine, who have studied under strict regulations at one or other of the colleges of the University. The government of the University consists of the Duke of Devonshire as Chancellor, a Vice-Chancellor, the University Court, and the University Council, whilst the academical arrangements for examinations, &c. are placed under the direction of the Board of Studies of the University, consisting of the examiners and of the professors and lecturers of the University, the former of whom are in part external to the teaching staff the latter being professors and lecturers in the O Although only in Its history.

Victoria University.

existence for a few years, the Victoria University has already granted a considerable number of degrees in arts and science, both in honours and the pass subjects, and the number of candidates for these degrees, as for the more recently instituted degrees in medicine and surgery, is now very considerable, and there can be no doubt that the foundation of a teaching university in the midst of the densely populated industrial districts of Lancashire and Yorkshire, will in time do much to stimulate and extend the higher education of the country.

The Owens College teaching staff.

The Owens College is governed by a President, the Duke of Devonshire, a court of governors, an executive council, and an academical senate. This latter body consists of 26 professors, including the principal, Dr. Greenwood, who occupies the chair of Greek. The scientific subjects are very fully represented. Then there are two professors of chemistry, inorganic and organic, besides four assistant lecturers and demonstrators; two professors of physics, and one assistant lecturer and demonstrator; a professor of applied, and one of pure, mathematics, with two assistant lecturers; a professor of each of the subjects of botany, biology, geology, and physiology, with assistant lecturers and demonstrators in each of these departments; and, in addition, a complete staff of professors and demonstrators for all the subjects of medicine and surgery. The laboratories and lecture rooms for chemistry are, perhaps, the most complete in the country, and the same may be said for several of the other scientific departments. Large biological and geological museums, with very complete accommodation for teaching these subjects, are now in course of erection.

Laboratories and museums.

College funds.

The total funds of the college amount to upwards of 400,000*l*., the whole of this sum having been either bequeathed to the college or raised by public subscription. No pecuniary aid of any kind has as yet been given, either to the college or to the University, by the government or the municipality.

Courses of study and number of students.

The courses of study are of an extended character, leading up to the University degrees, and to the college honour certificates in the technical branches of engineering, and technological chemistry. The number of students of arts and science in the day classes amounts to about 400; that in the medical department to nearly 300. In addition to the day instruction, which, of course, forms the chief work of the college, systematic courses of evening lectures and laboratory practice exist, for the benefit of the large number of persons who, being occupied in trade or otherwise during the day, are desirous of continuing their education. The number of evening students amounts to about 700; the subjects taught are the same as in the day classes, all the professors and the assistant lecturers taking part in the tuition, and in many subjects several courses are given; thus, in chemistry, there are three distinct courses of lectures, and three courses of laboratory practice, and

Evening classes.

in Latin five separate classes; so that persons desirous of carrying on their education up to a University standard, have the opportunity of so doing at the low fee of 10*s.* 6*d.* for the course of 20 lectures. These college evening classes serve, in the science subjects at least, as an excellent supplement to the ordinary science teaching under the Department of Science and Art, and to the elementary science instruction given in the board schools, placing a high standard of instruction within the reach of all resident in the district.

Visit to Owens College.

The Commissioners visited the College, where the Vice-Chancellor, Principal Greenwood, met us, and made the following statement with regard to the subject of our inquiry:—

Dr. Greenwood's statement

"The attention of the Council and Senate has been for many years given to the best way of so directing the strictly scientific instruction of the college as, without impairing its thoroughness, to foster the interests of the great manufacturing industries of the district.

"In the year 1868, Dr. Roscoe and I visited, at the request of our Council, some of the principal technical schools of Germany and Switzerland, with the view of ascertaining in what directions the higher education could best promote the interests I have mentioned, and at the same time of inquiring into the form of building and the appliances which had been found most effective.

"Accordingly, when our new college buildings were erected in 1870, we were able to make very complete provision for the teaching of chemistry, and less complete, but still considerable, provision for other branches of technical instruction, and that without, as we believe, in the least interfering with the prosperity of the teaching in arts and (pure) science, which is the proper business of the college.

"The details of those efforts, as well as of some further extensions which we are now contemplating, will no doubt be supplied to the Commissioners by my colleagues, the heads of the several departments concerned. I will only state here that two clear principles have been kept in view by us all along—(1) that a sound knowledge of principles ought to precede this practical application; and (2) that in teaching the applications we shall not aim at superseding that practical training which can only be gained in the manufactory or the workshop. We do not see any reason to doubt the soundness of these principles, and, so far as our experience goes, no difficulty need be found in drawing the line between those applications which may, and those which may not, be with advantage introduced into our instruction.

"On the one hand we believe that, so far as the absence of endowments for this special object has allowed, we have been able to contribute important services to our district, by way of sending out a number of well instructed young chemists and engineers, and on the other hand that we have not suffered from

the danger, which was not unreasonably anticipated by many, that the strictly scientific character of our teaching in these branches might be sacrificed to the needs, or fancied needs, of students that came to us to study science with an eye mainly to its applications. To illustrate my meaning, I will venture to say that no chemical laboratory in the kingdom has sent out a larger number than ours has sent of young chemists, qualified to take important posts in factories and chemical works, and yet it will, I think, be admitted that our laboratory has also not been unsuccessful in the contributions it has made to the progress of chemistry as a pure science—contributions, too, made not by the professor and lecturers only, but by not a few of its students of chemistry who are under training.

"In conclusion, I can confidently assure the Commissioners that the authorities of Owens College are desirous, so far as its funds allow, of adding to the efficiency of this side of our operations."

The several heads of the scientific departments met the Commissioners and favoured them with their views on the subject of the higher technical instruction, and with statements of how they endeavour to carry these views into practice. The evidence given by these gentlemen is found in the Appendix; we only here give a few of the more salient points.

Engineering department, Owen's College.

Professor Osborne Reynolds, F.R.S., made the following statement to us respecting the method of teaching engineering in the Owens College:—

"The two courses of study in engineering (day and evening) are arranged to meet the requirements of two very different types of students. The day students are for the most part between 18 and 23 years of age, and devote their whole time to the work of the college.

"The evening students are generally engaged during the day in works or drawing offices.

"The course of study arranged for the day students extends over three years, and includes engineering and drawing, practical surveying, mathematics, chemistry, physics, and geology, the students' time being divided nearly equally between engineering with drawing, and the other subjects. On the completion of the course, certificates of proficiency are given to those students who have passed an examination in all these subjects.

The number of students attending the day classes in engineering varies between 35 and 50; and about half the number of those who enter, remain to complete the course.

Many of these students are very clever, and come with a good preliminary education, and generally some of the engineering students are amongst the first in the mathematical and other classes.

"Besides these scientific subjects, the students are encouraged to, and largely do, avail themselves of the classes in modern languages.

Prof. Reynolds on the teaching of engineering

"The course of study followed in the engineering and drawing classes, has been determined by experience as that best suited to the requirements and capacity of the students, a considerable proportion of these having been in the works before they come, and the rest intending to serve their time in the works or offices after they leave. Thus no attempt has been made to provide a substitute for the workshop, and the course of study in the drawing-school is intended to fit a student to derive immediate advantage from the work he sees on entering a drawing-office, and give him a better understanding of the work, rather than to serve as a substitute for the drawing-office; great care, however, being taken to keep up the art standard of the work both in accuracy and style, as in these respects lies most of its educational value. The course in practical surveying is offered as much from its advantage as a matter of education as for its technical value, though one reason for this course is that opportunities of acquiring this knowledge systematically are very rare even to the pupils of civil engineers.

"In the engineering classes a certain amount of technical information is given, but this is not the primary purpose of these classes.

"The principal object is to teach the application of science to the purposes of engineering, to teach the scientific method of dealing with the problems of engineering, much after the manner of Professor Rankine's works on surveying, applied mechanics, and prime movers.

"The first year's course is surveying, estimating, the art of measurement, and descriptive engineering (in earthwork, masonry, and timber). The second year's course is applied mechanics (as far as the theory of simple structures, and strength of material, and the geometry of machines). The third year's work is dynamics of machinery, and hydraulics, and the steam engine. In the second and third years' subjects there is opportunity of introducing a good deal of descriptive engineering by way of illustration; but all through the effort is to give the students a thorough hold of what is brought before them, rather than to give them an imperfect acquaintance with a great deal. Thus the examples and illustrations are generally the simplest which serve. For this, diagrams and illustrative models are used, but what is mainly depended upon are actual experiments made before the class. In every case, by some means or another, the calculations are verified by actual experiment; for this purpose a considerable number of instruments and testing machines have been constructed, and use is also made of the engine which works the ventilator of the college. Visits are also paid to engineering works. I consider that too much trouble cannot be taken to familiarise students with the actual circumstances of the problems, instead of depending mainly on a quantitative statement.

"The teaching strength of the engineering department has not as yet been more than sufficient to deal with those branches of

the subject which are important to every engineer, and thus has not admitted of the detailed study of any special branches of engineering. But plans for extending the course and introducing more technical lectures on such branches, particularly mining and metallurgical engineering, have long been under the consideration of the Council of the College.

Comparison of English and foreign methods of teaching mechanical engineering.

"As compared with the parallel courses given in the polytechnic schools on the Continent, I consider that our course aims at a much smaller range of bookwork; that we leave the student to acquire by observation and experience much which they attempt to teach him; that our course is rather to teach him to understand what he sees, while theirs is to teach him how to produce things which he has not seen. This difference arises mainly from the fact that in England there are much greater facilities afforded for the acquirement of technical knowledge in the works.

Owens College. Engineering courses.

Where such facilities exist, the college training should be determined rather with a view to general education than to the acquirement of technical knowledge. Although, where the subjects are of equal educational value, it is clearly best to choose those which have the closest relation to the professional work.

"The educational value of such a subject as applied mechanics, with the necessary substratum of mathematical and scientific knowledge, is as high, if not higher, than that of any scientific subject; so that, whilst the student has acquired a knowledge of this subject, which will in all probability be highly useful to him in after-life, he has not in any way sacrificed his education in the acquirement of this knowledge. But the subject is too large to be mastered in three years, or indeed in any length of time, except by master-minds; so that the question of pressing this subject beyond the point which can be attained in the time which can be spared, for more general education, from professional or technical training, should be determined by the value of such teaching as compared with the more direct technical knowledge. It is true that there are some things for which a high general scientific knowledge is necessary; but these things are only to be accomplished by the master-minds. In an ordinary way, success in practical life depends on intimate familiarity with some narrow branch of knowledge; and to spend many of the years applicable for the acquirement of knowledge, on the generalities of a very large subject, must prevent or defer to a late period of life the acquirement of sufficient familiarity with any branch, in all its details, to be useful in a practical sense.

"Our course in Owens College is directed rather to the education of engineers choosing the most useful subjects, having regard to their educational value, than to the technical instruction of engineers in all branches of the subject."

Geology and proposed Mining department.

Prof. Dawkins, F.R.S., made the following statement on the projected formation of a *Mining School:*

"I take it that the Mining School in a place like Manchester should be for the instruction of the colliery viewers, and also of

those who have the charge of the large metal industries in Lancashire, a metal industry that extends on the one end into North Wales and on the other into Cumberland and Westmoreland. My idea is that the class of instruction should be mainly for the managers, &c., but also of such an informal nature that it might be available for the lower people employed in the mine."

Physics at Owens College.

The physical laboratories, under the direction of Professor Balfour Stewart, F.R.S., are well fitted with apparatus, chiefly instruments for measuring. From 30 to 40 students go through a systematic course of practical physics, including exact measurements of weight and length, thermometry, and electrical and magnetic measurements. The advanced students take higher work of a similar character.

Evening class on technical applications of electricity.

Professor Schuster, F.R.S., gave particulars of an evening practical class on the technical applications of electricity, which he has established with the assistance of Mr. Gee. The class is intended to give to persons occupied during the daytime, instruction in the scientific principles involved in terrestrial and submarine telegraphy, telephony, the construction and use of dynamo-machines, electric-lighting, &c. The instruction is partly theoretical, but chiefly of a practical nature, special stress being laid on the methods of exact electrical measurement. Students entering such classes ought to be acquainted with the elements of geometry, but a knowledge of the higher branches of mathematics is not absolutely necessary to the understanding of a large portion of the subject. About 40 students entered this class in 1 82–3.

Chemical laboratories. Owens College.

The chemical laboratories, directed by Professor Roscoe, are very complete in their fittings and general arrangements. They accommodate 100 working students, 60 in the junior or qualitative, and 40 in the senior or quantitative, laboratory. Plans and description of these are published by Mr. Cornish, Piccadilly, Manchester. The chemical department of the college is one of its most important features; organic chemistry is professed by Mr. Schorlemmer, F.R.S., and four demonstrators and assistant lecturers supplement the instruction given by the Professors. The aim of the Director has been to impart a sound knowledge of the theory and practice of chemical science, to fit students either for a purely professional career, or for the practical requirements of the very numerous branches of trade and manufactures which have their foundation in chemical science. In order to point out more clearly the course of study which should in the latter case be pursued, Professor Roscoe has drawn up a systematic course for technological students, the only course of the kind at present existing in this country. It is arranged on a liberal basis in order to secure not only a satisfactory knowledge of chemistry, but to give sufficient training in the allied sciences in mathematics, physics, mechanical drawing, and the no t subject of modern languages (*see* Appendix).

Syllabus of courses on technological chemistry at Owens College.

The complete course of instruction extends over four years, and embraces the following subjects:—

FIRST YEAR.—*Preparatory Course.*—Chemistry Lectures, Junior and Tutorial classes.
Chemical Laboratory, two days per week, and Analytical Chemistry Lectures class.
Mathematics class, Section I.
Experimental Mechanics.
Geology (Stratigraphical).
French or German.
Geometrical Drawing Lectures (Evening class).
Mechanical Drawing, Practical (Evening class).

SECOND YEAR.—Chemistry Lectures, Junior, Senior, and Tutorial classes.
Chemical Laboratory, three days per week.
Technological Chemistry Lectures (First Course).
Experimental Physics or Mineralogy Lectures.
German or French.
Geometrical Drawing Lectures (Evening class).
Mechanical Drawing, Practical (Evening class).

THIRD YEAR.—Chemistry Lectures, Senior and Tutorial classes.
Organic Chemistry Lectures.
Chemical Philosophy.
Chemical Laboratory, three days per week.
Technological Chemistry Lectures (Second Course).
Physical Laboratory, one day per week, or
Practical Mineralogy and Technological Mineralogy.
Mechanical Drawing, Practical (Evening class).

FOURTH YEAR.—Organic Chemistry Lectures.
Technological Chemistry Lectures (Third Course).
Chemical Laboratory, four days per week.
Chemistry of Colouring Matters, Dyeing, and Calico Printing (4th Evening Course).
Mechanical Drawing, Practical (Evening class).

The fees for the above courses amount to about 28*l.* per annum.

Certificates are granted to students on the successful completion of this course. Attendance on the full course of four years is expected of candidates for the certificate, but students may obtain exemption (on a satisfactory cause being shown) from the first or the first and second year's course. Students so excused will nevertheless be required to undergo examination in all the subjects specified.

The certificate will state in which subjects the candidate has gained honours, and in which he has merely satisfied the examiners.

A syllabus of the courses will be found in the Appendix.

The Lecturer on Technological Chemistry, Mr. Watson Smith, informed the Commissioners that the above course is almost identical with that of the Zurich Polytechnic School, and added that not only is a knowledge of the sciences allied to chemistry insisted on, but that a modern language and mechanical drawing are compulsory subjects. He knows of no other college in this country in which such systematized courses on technological chemistry are given.

Manchester Public Art Gallery.

Manchester Public Art Gallery.—The Public Art Gallery of Manchester was established little more than a year ago under the powers of the Manchester Corporation Act, 1882 (45 & 46 Vic. cap. cciii.). By the terms of this Act the Corporation of Manchester took over the land, building, and all other property of the Royal Manchester Institution, a Society established in the year 1832 for the advancement of "literature, science, and the arts." It was a condition of the transfer that the governors of the Royal Institution should elect from time to time one third of the managing committee of the Art Gallery. This mixed committee commenced its work at the beginning of the year 1883, and proceeded at once to develope a permanent collection, on the one hand, of original paintings, and, on the other hand, of examples of industrial art and of reproductions of sculpture and pictures. In the latter part of the committee's work much encouragement and assistance was given by the Science and Art Department, together with aid from the Government grant applicable to the purpose. A considerable sum was also subscribed by private persons in Manchester, and the Art Gallery has thus become possessed of a large and admirable collection of ancient textiles purchased from Dr. Franz Bock, from whom also the "Bock" collection of ancient textiles at South Kensington was obtained, and of a considerable number of casts from antique and Renaissance sculpture, as also of autotypes, photographs, and engravings from the drawings and paintings of the old masters. The "Bock" collection is particularly rich in silk fabrics. It contains also a large number of examples of ancient embroideries and laces, together with an admirable, but unfortunately relatively small, collection of old linen and cotton prints. This branch of the collection will, no doubt, be developed as opportunity may offer; and in the meanwhile, by the liberality of the authorities of the South Kensington Museum, a large and very rich loan collection of Indian fabrics has been placed in the hands of the Art Gallery committee, and forms a valuable supplement to their permanent collections. The collection of textiles is intended to be specially of service to designers, who have already made some use of it. Arrangements are about to be made for their greater convenience in copying. The permanent collections ar[illegible]s free to the public, and the Gallery has recently [illegible]undays as well as on week days; the numbe[illegible]e four

Sunday afternoons ending January 6th 1884, having been 10,308.

Manchester School of Art.—The Commissioners also visited the new buildings of the school of art in Cavendish Street. Particulars of this visit will be found in the Appendix

XV.—LIVERPOOL.

City of Liverpool.

The Commissioners were received at the Free Library by the Chairman of the Library Committee, Sir James Picton, Mr. Alderman Samuelson, and the officers of the Committee.

Free Library, Museum, Art Gallery, &c.

The Corporation of the City of Liverpool initiated the Free Library in 1850, and in the following year an Act was passed establishing the Free Public Library and the Derby Museum, and authorising the levy of a rate of 1*d.* in the pound for their support. Sir William Brown gave a magnificent building for Library and Museum, costing 40,000*l.* Since then a new Reading-Room has been erected by the Corporation at a cost of 25,000*l.* In addition to these, Mr. Joseph Mayer bequeathed to the city his collections of historical art, now located in a building adjoining the Derby Museum; and an Art Gallery was erected by Sir Andrew Walker at a cost of 36,000*l.*, of which an extension is now in progress estimated to cost 11,000*l.*

Corporation free science lectures.

Free scientific lectures are given during each winter in a large Lecture Hall, also erected by the Corporation, capable of seating 1,100 persons. The total outlay on these buildings, which lie close together, has been 230,000*l.*, and the annual expenditure on the staff, and on books and specimens, is 13,000*l.* In addition to this outlay, the Corporation has voted a sum of 30,000*l.* for the purchase of land and buildings for the Liverpool University College. (*See* Appendix for Sir James Picton's statement, giving details.)

Liverpool School Board.

The system of instruction in elementary science introduced by the Liverpool School Board is similar in kind to that adopted in Birmingham. The following statement by the Clerk to the Board, Mr. Hance, explains this system, which we are happy to endorse as efficient and economical.

System of science teaching in Liverpool Board Schools.

"With a view to the provision in the curriculum of their schools, of some subject specially calculated to awaken and exercise the observing faculties of the children, the Liverpool School Board, acting on the advice of several eminent scientific gentlemen, in March 1877, resolved to introduce the systematic teaching of elementary science into their schools. The branches of instruction were selected from the limited number of science subjects included in the fourth schedule of the New Code of that date, viz., mechanics (or, the principles of natural philosophy) for boys, and domestic economy for girls. The instruction given

is necessarily based on the syllabus of each subject set out in the schedule, in order to qualify the scholars to earn grants under the Education Department; but in each case the subject, as arranged in the code, has been modified and extended so as to enable it the more readily to be taught by experimental demonstration to large classes of children.

Science demonstrator in elementary schools in Liverpool.

" The method of teaching the subjects, which has been found by experience to be capable of producing very beneficial results to the scholars, is to combine ordinary lessons by the teachers of the school with a system of experimental demonstrations given by means of specially appointed demonstrators. The apparatus required for the demonstrations is kept at a central laboratory, and is transferred from school to school, as required, by means of a light hand cart. In this way each demonstrator is able to give from 18 to 20 demonstrations per week. In order to simplify the arrangements for the demonstrations as much as possible, by providing for the same demonstration to be given in several schools in succession, the Education Department was, at the commencement of the scheme, requested to provide for the school-years of the different schools to end as nearly as possible at the same time; and this was carried out so far as to admit of the schools being arranged in two groups, the annual examinations of which fall in the autumn and spring respectively. In the case of domestic economy, the demonstrations are given only every alternate week, and the same is the case in the second stage of mechanics (taken by the Fifth Standard), but to the Fourth Standard, just commencing the subject of mechanics, one demonstration is given every week. In the intervals between the demonstrations, the teachers of the respective classes, who are supposed to be present at the demonstrations, are expected to go over with the children the subject of the demonstration; and in many instances their lessons are illustrated by simple experiments; and in order to enable the teachers (the larger number of whom have unfortunately had no special training for the subject) to perform their portion of the work the more satisfactorily, a simple text book has been specially prepared, containing reading lessons on the subjects of the demonstrations, and exercises to be worked by the scholars. The demonstrations have been given in several of the other elementary schools of the town, not under the Board, on payment by the managers of the schools, of a proportion of the expenses.

" At the present time there is one chief demonstrator, who has also to organise the instruction, and two assistants.

" The cost of the apparatus used in the school demonstrations for the five years during which the scheme has been in operation amounts to about 120*l.*, many of the articles having been provided in duplicate in consequence of the large number of classes.

Effect of science teaching as respects other subjects.

" That the introduction of this additional teaching into the schools has not, to say the least, been attended with an injurious

effect on the ordinary subjects of instruction, is shown by the per-centage of passes in those subjects for the last few years.

"In 1873–4 the per-centage of passes in reading, writing, and arithmetic was - 74·4
1874–5 „ „ „ - 74·5
1875–6 „ „ „ - 74·4
1876–7 (the year in which class-subjects were introduced) - - 79·0
1877–8 (the year in which science instruction was introduced) - - 85·59
1878–9 the per-centage was - - 87·1
1879–80 „ „ - - - 88·4

"The examinations in these subjects, held by H.M. Inspector, consist merely in the answering in writing of three or four questions, and do not, as the inspectors themselves remark, adequately test the work actually done. This is especially the case in Standard IV., where the inability of the children to express themselves satisfactorily in writing, is a great disadvantage to them in these examinations. Notwithstanding, however, these drawbacks, the per-centage of passes in the last examination in mechanics was in Standard IV., 58·6, in Standard V., 75·2, and in Standard VI., 76·3.

Opinion of Prof. Stuart on the results of science teaching in Liverpool Board Schools.

"Professor Stuart, of Cambridge, who in December 1879 examined the scholars for the Liverpool Council of Education Scholarships, remarked in his report:—'In two or three of the 'essays an amount of accurate scientific knowledge was manifested sufficiently considerable to attract my attention; and on 'further inquiry I found that the boys in question came from 'schools in which special scientific instruction has been given 'by the School Board. It seems not only to have been accurate 'and useful, but also to have laid hold of the boys' imaginations 'and interested them.' In 1880, the School Board requested Professor G. Forbes, of Glasgow, to examine the scholars in mechanics, with a view to ascertain whether the system of instruction pursued was producing good results.

Opinion of Prof. G. Forbes.

Professor Forbes, after a very careful examination, reported to the Board as follows:—'In all stages a great deal has been done, 'and the intelligence of the boys developed by the system pursued. 'With some boys I was quite surprised to find so much clear 'intelligence and comprehension of the subject in boys so 'young. * * * * I can positively assert, that by the 'present system some good results have been obtained, a few 'being quite remarkable.' Of the first stage, he says,—'The 'boys in these classes being very young, and having had little 'previous opportunity of educating their faculties, have improved 'their minds greatly by the study of mechanics.' Of three particular schools, by no means attended by the best class of children, he says,—'These three schools quite surprised me; if 'the schools could all be brought to this state of perfection, the 'School Board would have very much on which to congratulate

'themselves.' At the same time, he pointed out several details needing further attention, and gave many valuable suggestions as to the mode in which the system might be improved.

Science tuition of pupil teachers in Liverpool.

"In addition to the instruction given to the scholars, special science classes in connection with the Science and Art Department, have been arranged for the pupil teachers, so as to gradually train them to take an intelligent part in the work in the schools. About 70 male pupil teachers attend the central classes in mathematics, acoustics, light and heat, and electricity and magnetism; and about 100 female pupil teachers are under instruction in animal physiology. A short course of lessons in mechanics is also given each year to the male pupil teachers."

Much interesting information obtained from the Chairman of the Board, Mr. S. G. Rathbone, and others, respecting the subject of science teaching in the Liverpool Board Schools, will be found in the Appendix.

Liverpool Council of Education.

Mr. Christopher Bushell explained to us the action of the Liverpool Council of Education, a body of which he is the President. The object of the Council is to connect the Elementary Schools in the city with the Secondary Schools. For this purpose a system of prizes and exhibitions has been established, and independent examiners report on the quality of the papers which are set by them, and the Council acts on this report in their selection of the candidates. From the Secondary Schools the boys obtain an opportunity of passing to the higher Colleges or to the Universities of Cambridge and Oxford. (*See* Appendix.)

Liverpool evening science classes.

Evening Science Instruction in Liverpool.—A very important feature in the educational institutions in Liverpool, is the systematic series of evening science classes. There are two distinct organizations founded for this purpose, each of which carries on classes under the Department of Science and Art, without interfering with the other. They act as friendly rivals, and the result is that, probably, in no city in the kingdom are these classes more flourishing or doing better work than in Liverpool. One of these organizations is termed the "Liverpool School of Science," the other "The Liverpool "Science and Art Classes."

Liverpool School of Science.

Liverpool School of Science.—The following statement of the origin and present condition of the evening science classes connected with the first of these, was given to the Commission by Mr. S. Leigh-Gregson, of whose recent decease we learn with regret. The second organization is of a somewhat similar kind.

"The school owes its origin to the Free Public Library and Museum presented to the town in 1857 by the late Sir Wm. Brown. A few years later it was found that the building would not be complete until (to use the words of Sir W. Brown) 'it had attached to it a school of science for the benefit of 'all classes, but especially the artizans, in which lectures should 'be delivered and classes held where students could obtain, at a 'small charge, scientific information of the contents of the 'museum, and also receive technical instruction respecting the

' various trades in which they were respectively engaged.' The school was formally inaugurated in 1861 by Earl Granville, Lord President of the Privy Council. The first enthusiasm of its founders gave way in a few years, and at one time it was contemplated to abandon the scheme; but with the exercise of patience and toil, the students slowly but gradually increased until the numbers now reach 834, and the grant earned from the Science and Art Department, South Kensington, reached last year, 704*l.* for science and 36*l.* 1*s.* 6*d.* for art; being the largest grant yet claimed for ' payments on results.'

Evening science instruction in Liverpool.

" The number of students in the several classes and the subjects of instruction are as follows:

	1881.	1882.
Practical, plane, and solid geometry - -	37	26
Do. advanced classes	12	9
Machine construction and drawing - -	79	74
Do. advanced classes	17	15
Building construction - - -	43	60
Do. advanced class -	10	12
Mathematics—Stages 1 to 3 - -	205	246
Do. Stages 4 and 5 - -	7	10
Theoretical mechanics - - -	22	16
Do. advanced class -	9	5
Applied mechanics - - -	67	70
Do. advanced class -	17	25
Sound, light, and heat - - -	56	60
Magnetism and electricity - -	115	183
Do. advanced classes	18	16
Inorganic chemistry - - -	133	180
Do. advanced classes -	40	48
Do. laboratory - -	15	25
Geology - - - - -	19	11
Mineralogy - - -	10	4
Animal physiology - - -	39	7
Do. advanced class - -	6	4
Steam - - - - -	70	74
Do. advanced class - -	18	23
Agriculture - - - -	11	14
Phonography - - -	24	30
Technical drawing for carpenters and joiners - - - - -	68	43
Metallurgy - - -	—	8
Alkali manufacture - - -	—	10
	1,174	1,338
" Art classes—		
Freehand, geometry, perspective, and model drawing - - -	486	288

"These numbers probably have never been equalled by any other science school in the kingdom, and the foregoing list at once shows the scope and nature of the work undertaken. Liverpool School of Science.

"The students are drawn from all classes of the community, and are nearly all engaged in business during the day.

"Their ages are as follows:—

Advanced Apprentices.	Under 15 years	-	44
	Over 15 and under 18 „	-	192
	Over 18 and under 21 „	-	219
	Over 21 and under 25 „	-	147
	Over 25 „	-	168
	Unknown - -	-	29

"There are 721 males and 78 females.

"A special feature of the system of instruction is that, as far as possible, the teachers are practical men, drawn from the ranks of our own students, according as they display special fitness for the work. Another feature is the removal from our prospectus of the term "artizan" on account of its ascertained unpopularity. We use, instead, the terms "Students A." and "Students B." In former years the opinion prevailed that "artizans" referred exclusively to labouring mechanics of humble origin; but in the present day we find the youth of the better classes working in the foundries, workshops, mills, &c., side by side with, in many cases, their fathers' workmen; and these better class students join more readily to an educational institution which appeals to all classes alike, instead of appealing specially to "artizans." Special features of the Liverpool system of science teaching.

"Our present system of instruction appears to answer well, but could be improved by aid of specimens specially prepared for tests, such as iron or wood for ductility, strains, &c., compounds for chemical analysis, &c., and by the erection of a model workshop, with working models.

"The following facts have come under our notice since the founding of the School of Science:—

"(*a.*) Employers find that the apprentices attending at the science classes comply more faithfully to the terms of their "indenture," and bring greater intelligence to bear upon their handicraft.

"(*b.*) Marine and other engineers have adopted the certificates of the Science and Art Department as a standard of theoretical knowledge for all applicants for employment.

"(*c.*) Some employers reduce the term of apprenticeship for youths possessed of the science certificates. For instance, a shipbuilder informed me last week, when inquiring for a lad to enter his drawing-office, that for a lad acquainted with mathematics and mechanics he would take off two years from the usual term."

Classes inspected by the Commissioners.

Several of these evening classes were inspected by the Commissioners. (*See* Appendix.) The teacher of one of these, Mr. Sloane, taking practical mechanics and steam, has been good enough to furnish us with an interesting letter giving his views on the kind of instruction suitable for mechanical engineers, pointing out the necessity for furnishing the teachers of the above subjects with proper models, besides giving a description of the requisites of a mechanical laboratory. (This will be found in the Appendix.)

Liverpool Institute.

Liverpool Institute.—This is one of the largest of the secondary schools in the city, where much attention is paid to science-teaching. It is one of the schools into which large numbers of boys from the Board schools pass with exhibitions, &c. given by the Council of Education.

Principal's Statement.

The principal, Rev. J. Sephton, M.A., stated that the institution is divided into a high school and a commercial school. There are about 800 pupils in the commercial school and 360 in the high school. Over 200 boys enter the institute every year from the elementary schools, principally the Board schools, by scholarships from the Council of Education when they have passed the Sixth Standard. The bulk of them stay from six months to a year to finish (as they term it). The institute has no entrance examinations; all that is required is that a boy shall be able to read and write, and if he can, there is a class suitable for him. Only the two highest forms in the commercial school are taken to laboratory practice, and this elementary; but the first class of the high school, numbering 12 to 15, have advanced laboratory practice. There are about 40 pupils from the commercial school and 30 from the high school who have elementary practice. Magnetism and electricity are taught as well as chemistry, and the most successful pupils are sent up for the South Kensington examinations. The best masters are found to be those who have been boys educated in the building. The institution was formerly the Mechanics' Institute, and a few of the old mechanic members of that institute still remain, sharing some of the privileges of the institution. Mr. McAlister, the senior wrangler in 1877, was a pupil of the institute. (For further particulars and opinions, *see* Appendix.)

Liverpool School of Art.

Liverpool School of Art.—This is connected with the institute, and is housed in a new, convenient, and handsome building, containing studios, art class rooms, and lecture rooms, erected mainly at the cost of a member of the Committee. The school has both day and evening classes. The course of instruction is a severe one, including drawing from models and from life. In the evening classes about 100 pupils, chiefly artizans, attend, and most of these are engaged in learning mechanical drawing. Last year nearly 2,000 drawings, mostly by artizans, were sent up to South Kensington for adjudication. Mr. Finnie, the master, favoured us with his views on art teaching as applied to design, &c. These will be found in the Appendix.

University College, Liverpool.—The Commissioners visited the buildings of the new University College in Ashton Street, originally occupied by a public institution which has been removed to other quarters. The buildings, which at the time of the Commissioners' visit were in process of alteration, occupy a very considerable space of ground, which has been transferred to the University College by the Corporation of Liverpool, on exceedingly liberal terms. The Commissioners were received by Professor Rendall, the Principal of the College, who conducted them through the various departments. Liverpool University College.

This institution has been recently founded by benefactions to the amount of upwards of 105,000*l.*, from some of the wealthy inhabitants of the city and its neighbourhood, with the view of providing for a higher scientific and literary education in the district than has heretofore existed. The departments of Chemistry and Physics are well arranged. A new Chemical Laboratory is about to be built. The system of instruction is similar to that carried out in Owens College, and in all probability the Liverpool University College will soon join the Victoria University as one of its incorporated colleges.

Professor Lodge (Physics) described to us the method of teaching which he pursues, and pointed out the importance attaching to courses of Electricity as applied to industrial purposes. The College authorities desire to undertake the work of the highest science teaching, and do not propose to interfere with that given in the excellent evening science-classes which exist in Liverpool, and which prepare for the examinations of the Science and Art Department.

The Royal Liverpool School of Medicine is now incorporated with the College as its medical faculty. The results of interesting conversations held with the Professors will be found in the Appendix.

XVI.—Oldham.

Oldham School of Science and Art.—This is mainly an evening school, adapted for the technical instruction of young men engaged in the various mechanical and textile works in the neighbourhood. It may, in our opinion, be regarded as an excellent sample of the kind of school which should exist in every industrial town in the kingdom; care of course being taken to arrange the instruction so as to be applicable to the several requirements of the districts in which they are situated. Oldham School of Science and Art.

Mr. Phythian (C.E. of Glasgow University), head master of the school, submitted the following statement of its origin and development:—

"As far back as 1840, Science and Art evening classes were commenced in connection with the Oldham Lyceum, when that institution was in embryo. Superior workmen, such as draughtsmen, in the employ of Messrs. Platt, were in the habit of teaching some science subjects of importance to their trade. As Introductory statement by head master.

Oldham School of Science and Art.

a development of these classes, the late Mr. John Platt, M.P., built, at his own cost in 1865, the first school of Science and Art, adjoining the Lyceum. Mr. Platt also provided a fine set of art casts, and the firm of which he was the head gratuitously supplied the internal fittings of the institution. About the same date the school was incorporated with the Science and Art Department, South Kensington, funds for its maintenance being provided by annual subscriptions, class fees, and payments on results from the Department. In a few years the desire for a chemical laboratory having arisen, Mr. Wm. Richardson supplied the funds for apparatus and chemicals; this was followed by the furnishing of a physical laboratory for experimental work for the students, in sound, light, heat, steam, magnetism, and electricity. The establishment in 1874, by the Society of Arts, of technical examinations, was taken up with successful results. Since then, students of these classes have gained 17 prizes, 4 in honours with 6 medals, value 85*l.*, and several full technological certificates. Five years later, the school was incorporated with the City and Guilds of London Institute for the advancement of Technical Education.

"The growing success of the school encouraged the president, Mr. S. R. Platt, and other sons of the late Mr. John Platt, to erect at their own expense the present handsome and commodious edifice, which contains 9 main rooms, 42 feet by 28 feet, 16 feet high, chemical and physical laboratories, with masters' rooms. The land was given by Mr. Richardson.

"There are three local exhibitions of 50*l.* per annum, tenable at the Owens College, Manchester, given by Mrs. Platt and Mr. Chas. C. Lees.

"The school has a small library of scientific books, presented by various publishers.

"The gross total of prize money received since 1867 is 6,066*l.* This amount, being awarded to the students, forms no part of the revenue of the school. All grants, fees, and subscriptions are received by the Committee, who pay the masters fixed salaries.

"There are now (1882) in attendance 675 science and 110 art students, varying from 13, the minimum age of admission, to 40 years; the average age is about 19. Most of them are young men in training to fit themselves for their after-career. They are chiefly young mechanics engaged in Messrs. Platt's and other works in the district. An effort is made to know the subsequent positions of the students, and a register is kept. The majority of them now hold responsible positions in the town and elsewhere, and many join the "Old Students' Association," assisting by subscriptions and otherwise towards the support of the school. In the classes the science subjects are, as far as possible, treated experimentally by the students, in accordance with the suggestions made by Dr. Roscoe, Mr. John Platt, M.P., and Mr. Wm. Richardson, as contained in the Report of the

Royal Commission on Scientific Instruction, published 1872. Literary classes are held in the Lyceum night classes.

The science course is chosen with special reference to the principal trades of the district, namely, machine making and cotton manufacture. The subjects are embraced in the prospectus of Sir Joseph Whitworth's scholarships for mechanical science, and are practical geometry, machine drawing, building construction, mathematics, theoretical mechanics, applied mechanics, sound, light, and heat, magnetism and electricity, inorganic chemistry, theoretical and practical, geology, steam, free-hand and model drawing, with technical classes for mechanical engineering, tools, and cotton manufacture.

" In 1865 there were 114 students on the books; in 1881 there were 549 students, a progressive advance having taken place during the whole interval.

Success of Oldham School of Science and Art.

" The following is a summary of the successes of the school since it was opened in 1865:—

" 11 of the Whitworth scholarships, and 11 prizes - - - - } Total value of Whitworth grants, 4,060*l.*
8 Whitworth exhibitions, and 2 studentships - - - - }
1 Bremner exhibition.
4 gold, 7 silver, and 6 bronze medals; grant of these medals discontinued since 1876.
10 national medals for honours.
5 medals for technological examinations."

Opinion of Mr. Richardson as to the value of the school.

The school is an evening one, and we inspected the drawing-rooms, class rooms, and laboratories whilst the classes were in progress. Mr. Richardson, on being asked whether he was satisfied with the mode in which mechanical drawing is taught in this institution, answered by saying that they carry off many prizes from South Kensington, "and they say that we excel;" and, when asked if the South Kensington authorities were the best judges, replied: "Well, we can make use of the people " after they have been here." The method adopted in teaching drawing was explained to the Commissioners by the master. It combines black-board with ordinary free-hand drawing, and drawing from models, and at the same time machine drawing.

Class on Cotton Spinning.

The Commissioners next visited rooms in which elementary geometrical drawing was being taught by Mr. Armitage, and solid geometrical drawing by Mr. Philip, M.A., and then inspected the large class (90 pupils) on cotton spinning, taught by Mr. Isherwood, Manager of the Tonge Vale Spinning Company; we were informed that 19 out of every 20 of these pupils were factory hands, and eight persons present were shareholders in the limited mills which are common in Oldham. Many of those in the spinning class attend science classes, especially in mathematics and theoretical mechanics. Upon being asked wh was in his opinion the value of such technological cl as that on cotton spinning, Mr. Richardson replied:—

Oldham Science School.

" students here give attention to the practical element of " the business followed by them. They have to answer " practical questions. The theoretical instruction they get " in the other classes is developed into practical instruction " in the technological classes. This seems to me to be the great " object of the technological classes, and I believe the object is " attained. They teach a man to understand the nature of the " materials with which he is going to work. For instance, a " man being examined in steel, it makes him study the nature " and qualities of steel. I think it is valuable for the students " to learn more of the nature of the materials with which they " work, than they would do were they only to learn applied " mechanics, engineering, chemistry, mathematics, &c. We may " say that the influence of the technological classes may be " economical or educational, or both, and in any case useful."

Physical Lecture Room and Laboratory.

We next visited the Physical Lecture Room and Laboratory, which works at physics in connection with the Science and Art Department. Mr. Phythian explained that two students working together perform a series of experiments similar to those of the Department in chemistry. The black-board and students' note books are divided into squares as in the other departments, and thus the quick preparation of correct drawings is facilitated By means of this system very complicated drawings are readily copied. The instruction in the practical class is conducted by means of written sheets describing the details of the experiment, with drawings of the necessary apparatus; these are copied by the students and used by them in the practical work. The same system is carried out in the teaching of practical chemistry.

Class on building construction.

In the class on building-construction about 50 students were present; and in the Art School young men and young women were occupied in free-hand drawing from copies, and in drawing from the cast.

Chemical Laboratory

The Commissioners next inspected the chemical laboratory, which is excellently fitted. Each student has a swinging seat and a sliding desk fitted with ink, &c., with cupboards beneath. There is one gas chamber to every four students, and this has a Bunsen flame inside. There are about 28 working benches, and these are used, at different times, by 60 students. All the students work experimentally in chemistry, going through the experiments mentioned in the Science and Art Directory. The more advanced students work at qualitative and quantitative analysis.

In addition to the practical work, there are chemical lectures, and the students work out chemical calculations.

Opinions of leading Oldham manufacturers as to influence of these classes.

In reply to a question respecting the influence of these Science and Art classes on the industries of the town, Mr. James Taylor, of the firm of Buckley and Taylor, Engineers, replied :—" Very beneficial, I think. In the case of pattern " makers, for instance, they understand their work better than

" they did previously. It has caused the men to be more " intelligent workmen and to understand better the instructions " given them, and the object had in view in the work " performed, and they understand the working better. Our " foreman draughtsmen are now all taken from the institution. " Before the institution existed we used to get Swiss and French " and Germans principally. Now there is hardly a foreigner in " the town."

Mr. Richardson added, "I can confirm this statement. The " working mechanics are much more intelligent. Now, a man " can be sent out to work and can transmit his views to the " firm in writing, give sketches, and reason about matters; " formerly the man would have had to return to the works " and get personal instructions in all cases of difficulty; the " suggestions they make to remedy defects are more practical " than before. Every man may now be equal in intelligence " to what the master was before the school was established."

About 25 per cent. of the students are employed in Messrs. Platt's works. Almost all the young men of the works attend. No special inducements are offered to the young men by the proprietors of the works, to attend these classes; the only stimulus being the South Kensington prizes and the Whitworth scholarships. No pressure is put on the students; that is, none but a moral pressure. If a man wants advancement he is asked questions bearing on his work at the Science School, and the matter becomes simply one of qualification.

Mr. Ernest Raynor (manager at Messrs. J. Braddock's Globe Meter works) stated that they had found since the establishment of the Science School that it was a good deal easier for foremen to take charge of men than it was formerly. The men could be more readily trusted with a job, and they understood what they had to do with less explanation.

XVII.—Barrow-in-Furness.

Visit to Barrow-in-Furness.

This town was visited by the Commissioners, under the guidance of Alderman John Fell, Mayor, and Mr. Fillingham, Clerk to the School Board.

The town of Barrow owes its rise and progress to the rich deposits of hæmatite iron ore found in the district of Furness. Only a few years ago it was a hamlet composed of a few cottages by the sea shore. So rapid has been its growth, that in 10 years, between 1861 and 1871, its population increased six-fold, and between 1871 and 1882, from 18,000 to 47,000.

Elementary and higher schools.

The energy and zeal of the School Board have been fully required to keep pace with the educational wants of the town. Under the Chairmanship of the late Lord F. Cavendish, and

more recently of the present Mayor (Alderman Fell), a number of elementary schools have been built, supplying efficient accommodation and effective teaching.

Kindergarten system, Barrow.

The Kindergarten system of teaching is adopted in some of the infant schools.

In 1880, on the initiative of Sir James Ramsden, who from the infancy of the town has warmly promoted every movement for its intellectual, social, and material advancement, a higher grade school was established, and at the time of our visit was about to be re-organised so as to provide for the secondary education of all classes, and particularly for the grounding of artizans in the principles of science and art.

Science classes.

Connected with the higher grade board school, there are evening classes in chemistry, magnetism and electricity, mathematics, and physiography. 30 students were presented for the examination in 1881–2.

School of Art.

The school of art was erected at the sole expense of Sir James Ramsden, and is connected with the Science and Art Department. There are about 250 students, and instruction is given in drawing, painting, sculpture, applied mechanics, and architectural designing.

School of Cookery.

A school for the teaching of cookery and other household work was started in 1880. During the past year about 400 girls from the elementary schools attended the classes in groups of 20. It is now proposed that *all* the girls from the elementary schools of the town shall attend the school.

University extension lectures.

In connection with the University extension scheme, courses of lectures by Professors and Fellows from the University of Cambridge are given to artizans during the winter months.

Working men's Institute and Club.

The most popular of the educational and social institutions of Barrow, is the Working Men's Institute and Club. The premises were erected by subscription, at a cost of 3,450*l*. There are 500 members. On the ground floor is a reading room and library of 1,500 volumes, billiard and class-rooms, kitchen, offices, &c., and on the upper stories a lecture hall and billiard room. The lecture hall is used by the Barrow Field Naturalists' Club for lectures, and contains a large number of specimens of minerals, fossils, ores, birds, and animals, &c., which have been collected by the members in their excursions in the neighbourhood.

Visits to works.

The Commissioners visited the great industrial works of the town, and conferred with the proprietors on the subject of the Commission.

Deficiency of means of scientific and artistic training of artisans.

All the gentlemen with whom we conversed, concurred in the opinion that in the means for the higher scientific and artistic training of artisans, Barrow is seriously deficient. The population of the town has quite outgrown the educational provision for youths

and apprentices, but we understood that the education question, particularly in its bearing upon the local industries is receiving most careful consideration at the hands of those public spirited and enterprising promoters of the town, to whom all classes of the population are already so much indebted.

XVIII.—Birmingham.

On the occasion of their visit to Birmingham, the Commissioners met the members of the School Board, and inquired into the system of science and art teaching under the Board. Birmingham School Board, science instruction.

Board School Instruction in Elementary Science.—Science is taught in accordance with the following syllabus: by a practical demonstrator and assistant (who visit each boys' and girls' department once every fortnight), and by the teacher of the school.

Method of Instruction.—The science demonstrator for the Board (or an assistant demonstrator) gives one lesson fortnightly, of about 40 minutes' duration, to the boys in the fifth and higher standards in each school. These lessons are illustrated experimentally by specimens and apparatus, carried from school to school in a hand-cart. Method of instruction in science.

Between the visits of the science demonstrator at least one lesson is given to the same class by the teachers of the respective schools (as a rule by a teacher who was present at the demonstrator's lesson, and took full notes of it), and a written examination on the subject matter of the lesson is also held. The answers are corrected by the class teacher and submitted to the demonstrator at his next visit to the school. A general examination in elementary science is held yearly.

Syllabus of Fortnightly Demonstrations for Boys.—Specification of a force; nature and action of machines; principle of work. The mechanical powers; conditions of equilibrium; the mechanical advantage; friction. The lever; parts of a lever; three orders of levers. Practical applications of the lever; double levers. Weighing machines; the balance; the steel-yard. The wheel and axle; practical applications of this machine. The toothed wheel; clocks and watches. The pulley; fixed and moveable pulleys; the three systems of pulleys. The inclined plane; its principle and applications. The wedge. The screw. Compound machines. Pressure of liquids; surface of liquids; liquids under the action of gravity. The hydrostatic press. The parallelogram of forces. The parallelogram of velocities. Science subjects taught to boys.

Syllabus of Fortnightly Demonstrations for Girls.—Structure of the human body; names and positions of the various organs; structure of the skin; the teeth. Circulation and respiration; impure air and ventilation. The organs of digestion; the brain Science subjects taught to girls.

and nervous system. Nature of food; necessity for food; quantity required; classification of food. Preparation of food; meat: its composition and culinary treatment. Fish, eggs, milk, butter, cheese: Principles regulating their use and preparation as food. Flour, pulse, peas, beans: their composition and preparation for the table. Starch, sugar, fruits, vegetables: their use as food. Condiments and beverages. Apparatus for cooking: how used. How to maintain the body in health: I., Fresh air and pure water are needful. II. A suitable dwelling, sufficient food, and exercise (work) are also required. The sick room: duties of a nurse. Contagious diseases: their origin and treatment. How to prevent them spreading. Diseases of children: how to help the doctor. Accidents: what to do in cases of cuts, burns, &c.

Science evening classes under School Board, Birmingham.

Classes for the evening instruction of pupil teachers are held at two centres, under the regulations of the Science and Art Department. Male pupil teachers take chemistry and magnetism and electricity; and females, physical geography and magnetism and electricity. At the examinations in May 1882, 18 first class certificates and 73 second class certificates were obtained by the 133 teachers who were examined.

Some of the schools under the Board are used for evening science classes in connection with the Midland Institute.

The Commissioners visited the Icknield Street Board School, which has been provided with an excellent laboratory in accordance with the requirements of the Science Directory. Here some of the senior boys and the pupil teachers have practical laboratory instruction in chemistry.

Instruction in handicrafts is not as yet given in any of the Birmingham Board Schools, but this matter is under the consideration of the Board.*

King Edward's Grammar School.

King Edward's Grammar School.—The Commissioners visited the King Edward's Grammar School, accompanied by the Mayor and Mr. Alderman Kenrick, where they were met by the headmaster, the Rev. A. R. Vardy, M.A. This is an ancient foundation school which has been reconstituted under a new scheme in 1878. The governing body consists of 22 members. Eight representative governors are elected by the town council, three are nominated by the Universities of Oxford, Cambridge, and London, and one by the teachers of the schools of the foundation. Certain governors of the old foundation still remain, but they will eventually disappear when their terms of office expire. The schools on this foundation are being entirely remodelled. They

* For the details of a proposed central school in which handicraft instruction would be given to selected boys of the upper standard, see letter from Mr. Davis, the Clerk of the Board, in Appendix.

consisted formerly of a high school, a middle school, and four lower middle schools for boys, and four for girls. It has been ascertained however, after trial, that there is not room in Birmingham for three grades of schools above the public elementary school, and the scheme about to be adopted distinguishes merely between the high school or central school, which will have departments both for boys and girls, and the middle schools which will take the place of the former middle schools and lower middle schools. The education given at the high school and at the middle schools differs only in degree, the curricula being very similar. The high school course is designed to educate boys up to the age of 19, whereas the middle school course terminates at 16, or at about the standard of the Oxford and Cambridge Junior Local Examinations. The students for the high school are not generally scholars from the middle schools, but a good many of the Board school children go into the middle schools. There are entrance examinations for both schools; the average age of entrance being 11. In the high school classical languages form the foundation of the education, though certain boys who are going in specially for science and modern languages may be excused Greek.

In the high school the arrangements for teaching science are antiquated and insufficient, and for some time to come, until it becomes possible to erect new buildings, the school and the class-rooms will be crowded, as the high school for girls has to be accommodated in a portion of the present building.

Science teaching.

The science teaching in the high school is under the charge of a master who devotes to it the whole of his time, and there is an assistant master who gives part of his time to these subjects. In the middle schools the staff will be about the same.

Grammar School, Five Ways.

The Grammar School, Five Ways, one of the schools on the same foundation, under the Rev. E. F. M.MacCarthy, M.A., as head-master, was also visited by the Commissioners. The instruction resembles that of the King Edward's School, but is not carried so far. The school buildings are modern, and we found that the foreign system of class-room fittings had been introduced; thus the rooms were surrounded with blackboards on which the boys draw simultaneously. There are dual desks, and the supply of teaching apparatus is good. In connection with a small lecture theatre are a preparation room and laboratory. There is a large room in which the boys assemble. The school contains 270 boys, all of whom, except the two lowest forms, receive science teaching from Mr. Atkins, the science master, who devotes the whole of his time to this instruction.

The several schools educate altogether about 850 pupils. The fee per term in the high school is 3*l.*, there being three terms to the year. In the middle schools the fee is 2*l.* per term, also with three terms per annum. Very few scholarships are given and the ildren of poor parents find a

difficulty in obtaining the benefits of these schools. The exhibitions, which are three in number, are too small to lead on to college. There are three exhibitions of 50*l.* per annum to Oxford and Cambridge, one for classics, one for mathematics, and one for general proficiency. There are 12 scholarships of 30*l.* per annum each in the middle schools.

Three of the lower middle schools buildings are condemned, and at the present time new school buildings are being erected in their place further away from the town. The arrangements in these latter schools are in transition.

Drawing teaching.

Drawing is only taught on half holidays, generally by members of the staff, on the School of Art basis, and in preparation for the Government examination.

High School for Girls, Edgbaston.

The Edgbaston High School for Girls was visited by the Commissioners. It is under the management of a council of shareholders, and provides an excellent middle class education for girls at moderate fees, varying according to age from five guineas to eight guineas per term. The head-mistress, Miss Cooper, conducted us over the school.

The Mason College, Birmingham.

The Mason College.—This institution was founded and endowed by the late Sir Josiah Mason, at a total cost of more than 200,000*l.* The building designed by Mr. J. A. Cossins, was erected under the personal supervision of the founder, who happily lived long enough to see the appointment of the first four professors and the work of teaching begun within the walls of the college. It was opened on the 1st October 1880.*

Intentions of the Founder.

The following extracts from the foundation deeds explain the intentions of the founder in establishing an educational institution. It will be shown presently to what extent the original plan has been modified. Deed, dated 12th December 1870 :—

"The Institution to be hereby founded is intended to be called 'Josiah Mason's Scientific College' or 'Josiah Mason's College for the Study of Practical Science'. . . . . and the said Josiah Mason hereby declares that his intention in founding the same is to promote thorough systematic education and instruction specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pursuits of the Midland District, and particularly the boroughs of Birmingham and Kidderminster, to the exclusion of mere literary education and instruction, and of all teaching of theology and of subjects purely theological; which limitations the said Josiah Mason hereby declares to be fundamental."

And the founder expressly declares the instruction to be given shall include the following subjects; viz.: "Mathematics, abstract "and applied; physics, both mathematical and experimental; "chemistry, theoretical, practical, and applied; the natural

* A complete description of the building, with plans, will be found in "The Architect" for January 8th, 1881.

" sciences, especially geology and mineralogy, with their appli- Mason College, Birmingham.
" cation to mines and metallurgy; botany and zoology, with
" special application to manufactures; and physiology, with
" special reference to the laws of health; and the English,
" French, and German languages; and may include all such
" other subjects of instruction as may be necessary to carry into
" effect the intention of the founder to give thorough systematic
" scientific education and instruction specially adapted to the
" practical requirements," &c., " but excluding mere literary
" education and instruction."

In accordance with these views, the building was designed to afford accommodation specially for instruction in physics and chemistry, and very liberal provision was made for the requirements of teaching in these departments. The first professors appointed represented the four departments of mathematics, physics, chemistry, and biology, and they commenced operations immediately upon the opening of the college in October 1880. Character of the buildings.

It soon began to be felt, however, that it would be desirable to extend the scheme so as to provide a complete curriculum, in science at least, for those students who desired to present themselves for the degrees of the University of London. Subsequently the founder was induced to give his sanction to the admission of anatomy and the Greek and Latin languages, and to " such a course of study as shall qualify for degrees in arts and " science in the Victoria University or the London University, " or any other University of which the institution shall form " part." (Deed of 23rd February 1881.) Modification of the course of instruction.

In the same deed the name of the institution is declared to be " The Mason Science College."

In June 1881 Sir Josiah Mason died at an advanced age. Acting upon the enlarged powers given them by the last deed, the teachers proceeded to appoint professors of physiology, geology, botany, engineering, Greek, Latin, and English; the professor of chemistry, with the aid of an additional assistant, was requested to undertake metallurgy; and lecturers were engaged to teach the French and German languages. Additional professorships.

Thus the Mason College, as it is now called, has developed out of what was essentially a technical school into a university college, with, however, a distinct leaning to science, notwithstanding the omission of the word from the title, and with provision for technical instruction in certain departments. Change from technical school into a university college.

The teaching of applied science in the college falls under four heads: First, instruction to the students of the Birmingham Medical School, in chemistry, physiology, and botany. Secondly, engineering,—a division which is in a fairly prosperous state considering the short time it has been established, and in which it may reasonably be expected that a great increase in the Applied science teaching.

number of students will ensue, when time has been given to allow of the college becoming better known.

Engineering, Mason College, Birmingham.

The teaching of engineering is distinctly practical, in the sense that its results are directly useful in professional and industrial engineering work; and "there is not the time to wander into "matter of merely theoretical interest. There is no endeavour to "make the students trained handicraftsmen, that being outside "the function of either school or college, and impracticable, "except in the regular workshop." But the pupils have a laboratory where they experiment on materials and on hand and machine tools, and on engine and boiler. They have to shape and temper the tools, and try results by accurate quantitative measurements. They can hardly fail therefore to obtain, in the Professor's opinion, so far as the intelligence of each individual enables him to do so, "a strong, concrete, and practical "idea of the subject they are studying."

The need of further apparatus for the complete equipment of the engineering laboratory is much felt.

The engineering department will give a junior and a senior engineering diploma, at the end of the second and third years respectively, to those students who have passed through the prescribed course of study and have gained certain positions in the periodical college examinations.

Metallurgy and applied physics.

In the third division, that of metallurgy, the attendance is small. The last division is that of physics, which is carried on by means of a course of special lectures, combined with laboratory instruction, on the applications of electricity in telegraphy, the transmission of power, &c.

Classes are open to both sexes.

The classes at the Mason College are open to both sexes on equal terms, and nearly one-fourth of the students (excluding medical students) are women. Of the male students the majority are sons of manufacturers in Birmingham and neighbouring towns, though a few come from London, Leicester, and other places at a distance.

Number of students.

The number of individual day students registered during the session ending June 1883, was 366, not including the medical students from Queen's College. Some estimate may be formed of the kind of work done, by reference to the following statement of the distribution of students in the several departments:—

SESSION 1882–3.

	Registered Day Students.
Mathematics, pure	57
„ applied	2
Physics	82
Chemistry	124
Metallurgy	8

Mason College.

	Registered Day Students.
Zoology	38
Botany	57
Physiology	86
Geology	53
Engineering	24
Greek	35
Latin	39
English	53
French	42
German	34
Logic	4

Birmingham has long been provided with good and cheap elementary instruction in science, in the classes at the Midland Institute, but until the establishment of the Mason College students desirous of instruction in its higher branches were obliged to proceed to universities and colleges at a distance from home.

Evening lectures.

From the commencement, evening lectures have been given in most of the departments, but the entries have fallen from 236 to 197 and 172 in successive years. This is probably in the main to be ascribed to the existence of the classes under the Science and Art Department, carried on in the Midland Institute at fees very much lower than those which are payable in the college. In the departments of applied science, such as chemistry and engineering, the attendance is fairly maintained, the decline being chiefly noticeable in the classes for languages and literature.

Exhibitions will be needed.

The next step must be the provision of scholarships or exhibitions for the benefit of deserving students from the elementary schools. These the present endowments of the college are insufficient to provide for. Indeed it is beginning to be strongly felt that its resources are too small for its present work, for in spite the greatest economy in the several departments, the income of the college, including the students' fees, falls short of the expenditure by several hundred pounds every year.

Birmingham and Midland Institute.

The Birmingham and Midland Institute.—This important institution occupies large and commodious buildings in the centre of the town. Ever since its establishment, 27 years ago, it has gone on increasing in numbers and popularity, and a few years ago the original building, erected at a cost of 18,000*l.*, on land given by the town of an estimated value of 10,000*l.*, having become too small for its requirements, it was decided to extend it at an estimated outlay of 38,000*l.* The land needed for this extension was acquired for the sum of 14,750*l.*, and with the interest on loans from the bank and necessary expenses, the estimated total outlay on land and buildings was stated to the

New buildings.

Commission at 81,750*l.* A large proportion of the cost has been raised by public subscription, but 13,200*l.* are still required to liquidate the expenditure. In its general constitution the society resembles the Mechanics' Institutes, but it differs from them in the multitude and importance of its classes, some of which are held in board schools in different parts of the town.

Midland Institute, Birmingham.

The ordinary members of the society are about 1,900, and pay an annual subscription of 1*l.* 1*s.*, which entitles them to attend the literary classes, the various lectures, and the conversazione, and to use the reading and recreation rooms. For the lectures, special tickets are issued to about 800 subscribers.

Industrial department.

Their is a special industrial department which is one of the most flourishing branches of the Institute, comprising 4,143 members in attendance at the numerous classes.

There are day classes for women. On Saturdays, the science classes are held from 12.45 p.m. to 9 p.m., so as to enable working men to devote their half-holiday to instruction, and this arrangement has been largely availed of. The classes lead up to the examinations of the Science and Art Department, of the Society of Arts, and of the City and Guilds Institute. The teachers are paid by salary, and have no share in the fees or grants. Numerous prizes are given by local benefactors of the school and by the committee of the institute.

Lectures on a variety of subjects are given in the handsome theatre on Monday evenings, and there is a special course during the Christmas holidays. Branch classes, nearly all of which are in the elementary stages of the different science subjects, are held in eight outlying quarters of the town, and have been found most invaluable as feeders to the institute. Penny classes are held in fifteen subjects, some of them in all their stages, and are extremely popular; as an example, a penny class for instruction in the violin commenced with 408 persons, and by the third night the attendance had reached 525. A summer field class in botany is extremely popular, and there is an archæological section with 234 members.

The gross receipts in the general department in the year 1882 were 3,112*l.* 13*s.* 6*d.*, and the expenditure 2,734*l.* 7*s.* 2*d.* In the industrial department the receipts were 1,761*l.* 8*s.* 5*d.*, while the expenditure was 3,137*l.* 16*s.* 3*d.*, whereby the institute was involved in a heavy loss; the balance of the deficiency on the two departments being thus 998*l.* 1*s.* 6*d.*

The Commissioners were conducted over the numerous class-rooms by the officers of the society; and they received formal evidence from Mr. C. J. Woodward, the science master, which will be found in the Appendix, Vol. III.

School of Art, Birmingham.

Society of Arts and School of Art.—The work of this society and of the school in connection with the Science and Art Department, was long carried on in the Midland Institute, but owing to want of space had to be transferred some years ago to

a separate building. We were met by the head-master, Mr. Taylor, and conducted over the various departments. Both day and evening classes are held here, and the teaching is strictly on the lines laid down by the Art Directory. Numerous local prizes are competed for annually. Branch classes in connection with the School of Art are held in several of the Board Schools; the instruction in the latter being in all cases confined to the elementary stages. The annual subscription to the Society of Arts is one guinea. There is a good art Reference Library, and lectures on art subjects are delivered during the course of the session.

Visits to factories.

The Commissioners, during their stay in Birmingham, inspected some of the principal manufactories, and discussed with the proprietors and managers the facilities provided by the various science and art classes for the training of their workpeople. They were informed that no classes exist in the neighbourhood under the City and Guilds Institute. Formal evidence was taken from some representative working men, respecting the nature of the teaching best adapted to the requirements of their trades. This will be found in the Appendix, Vol. III.

Evidence of workpeople.

XIX.—Leeds.

Yorkshire College, Leeds.

The Yorkshire College.—The Commissioners visited Leeds principally in order to see the textile and dyeing departments of the college. The buildings for this branch have been specially erected by the Clothworkers' Company of London at a cost of 15,000*l.*, and form a wing of the proposed new Collegiate buildings at Beech Grove. The Company has also endowed this department with a grant of 1,250*l.* per annum for five years, renewable under certain conditions. The buildings, erected from the designs of Mr. Alfred Waterhouse, are in the Gothic style, and are in every way admirably adapted to their purpose. The cost of the entire college will, it is estimated, be 35,000*l.*, and towards this sum 23,800*l.*, had been subscribed at the time of our visit. We were conducted to the college building by Mr. F. Lupton, the treasurer, and received there by Sir E. Baines, the chairman of council, Prof. Rücker, the principal, and the various professors. We discussed with them the present position of the college, and the system of teaching. Mr. Hummel, the teacher of dyeing, and Mr. Beaumont, the instructor in weaving, accompanied the Commissioners over their respective departments. The courses of weaving and dyeing extend over two years, and are so timed that it is difficult for the student to go through complete courses of both at the same time, but a thorough knowledge of one branch, and a general acquaintance with the other, can be obtained during the two years. Mr. Hummel informed us that he had been trained at Zurich, but he has had practical experience as a dyer in England. After visiting the

Buildings.

Dyeing school.

best foreign schools, he had erected the plant of his laboratory according to plans different from those of any foreign school.

Yorkshire College Weaving School.

The nature of the instruction in these departments is as follows:—In the elementary class-room there are 30 model hand-looms, counterparts of those in the shed. When the students have been initiated into the working of the models, they pass forward into the shed to complete their practical knowledge at the full-sized looms. In the weaving shed for the advanced class there are seven jacquard hand-looms, five hand-looms, three treadle hand-looms, one 400-hook jacquard power-loom, two 34-shaft power-looms, one 24-shaft power-loom, and two tappet power-looms. The power-looms are driven by a five-horse power "Otto" gas engine. There are also in the shed, card-cutting machines, bobbin-winding wheels, and other machinery. On these looms the finest and choicest fabrics for ladies' wear and the heaviest goods can be produced. A certain class of carpets can also be woven. "The "object is not to produce a quantity of one material or pattern, "but to introduce as many patterns as possible." The students are thoroughly taught the mode in which each pattern is woven, the several parts of which it is composed, and the quantity and weight of the materials employed. They each receive a set of sample patterns and a book containing the particulars relating to them.

Scale of fees.

The fees in the textile industries department are ten guineas per session in the first year, and eight guineas in the second. There is also a shorter course with a fee of five guineas per session.

Dyeing department.

The course in the dyeing department is as follows:—

First Year.	Hours per week.
Experimental Physics (first year's lecture course)	3
Chemistry (two terms)	5
Practical work in chemical, laboratory (three terms)	12
Mechanism, machinery and technical drawing	4
Lectures on colouring matters, mordants, &c.	3
Practical work in the dyehouse (three terms)	12

Second Year.	
Experimental physics (second year's lecture course)	3
Practical work in chemical laboratory	12
„ „ dyehouse	24

The fees in the dyeing department are for one day per week five guineas, two days nine guineas, three days 13 guineas, four days 16 guineas, six days 21 guineas per session. A considerable deduction is made in the case of students who do not reside in Leeds.

During the year 1882–83, there were in the college 401 day students, including 185 registered students, 55 medical, and 161 occasional students, and 223 evening students, a total attendance of 624. The fees paid by the students amounted to 2,746*l.* 11*s.* 6*d.* A very successful coal-mining department, endowed by the Drapers' Company, and under the charge of Mr. A. Lupton has been added to the college. The mechanical section under Professor Armstrong, and the chemical department under Professor Thorpe, though at present very ill-provided with class room accommodation, are very well attended. In fact, Professor Thorpe experiences great difficulty in finding places for his students, but in the new buildings, ample and most effective accommodation for the departments of chemistry and physics will be found.

Chemical department, Yorkshire College.

XX.—SHEFFIELD.

The Commissioners visited Sheffield and took much valuable evidence from manufacturers and others interested in the various educational establishments of the town. The evidence, which contains a full description of Firth College and its work, by Professor Viriamu Jones, the late principal, will be found in the Appendix, Vol. III.

Sheffield.

We were much impressed with the excellence of the system adopted by the School Board, for the management and instruction at their Central School. In this institution, as in the graded schools of some other towns, the best scholars from the surrounding board schools are gathered for more advanced teaching; all the pupils take the ordinary code subjects, together with some of the specific subjects; both boys and girls throughout the school are taught German. All the girls learn needlework and practice cookery; those in the higher classes take chemistry. Drawing is thoroughly taught, and is made the foundation for practical mechanical work, carried on in shops fitted up for the purpose. This latter comprises the production of simple but perfect, solids and surfaces in iron and wood, such as the cube, the hexagonal prism, &c.; also the construction of models in wood, suitable for use in schools, as examples for model-drawing; and various kinds of wood joints, model doors, &c.; likewise the construction of simple apparatus to illustrate by actual experiment the principles of levers, pulleys, wheel and axle, the crane, strains on beams with different positions of load, and the mechanics of the roof, arch, and bridge. The Commissioners were much impressed with the excellence of the drawing, including that for the industrial work.

Central Board School.

Laboratories and mechanical workshops.

Excellent results of the Sheffield Central School.

It is greatly to be desired that the Government would support this practical workshop instruction, without which the continuance of the scheme is scarcely possible. For a full account of the work of this school, see letter from Mr. Moss, the Clerk to the School Board, in Appendix, Vol. III.

XXI.—BRADFORD.

Bradford Technical College.

The Bradford Technical College.—By invitation of the president, Mr. Henry Mitchell, the Commissioners visited the Bradford Technical College on the occasion of the opening of the new buildings by their Royal Highnesses the Prince and Princess of Wales, and on other occasions.

Reasons for erection of College.

The erection of the College was the result of a prevailing feeling in the minds of many of the commercial community of Bradford, that, in the competition for the world's industry, it was becoming more and more needful to develope to the fullest extent, the technical knowledge of the employers and operatives in the various industries, on which the prosperity of the district depends. It was therefore decided that an institution should be founded, in which instruction should be given in the principles underlying the various industries of the town and neighbourhood.

Grant by the Clothworkers' Company.

A powerful stimulus was given to the movement by the generous contribution to the building fund of 3,500*l.*, as well as an annual grant of 500*l.*, by the Worshipful Clothworkers' Company of London, whose master for the year 1880, Lieutenant Colonel Britten, laid the corner stone of the new building. The outlay upon the building and furniture already exceeds 36,000*l.* The college is divided into departments for pure art, designing, weaving, chemistry and dyeing, mechanical engineering, and the sciences connected with the building and other mechanical trades.

Class-rooms and lecture hall.

In addition to the rooms for art, the chemical and dyeing laboratories, the weaving sheds, and mechanical workshops, there is a handsome lecture hall calculated to hold 600 persons, an extensive museum for textiles, raw materials, natural objects, &c., and a large and well furnished reading-room. In the several departments there are 838 students, of whom 184 are day, and 654 evening students.

Art Department.

The art department embraces courses of instruction both in pure art and in designing for textiles. This important department is under the charge of one of the most experienced art masters in the country, Mr. Walter Smith, who, for the last ten years, has held the post of art director of the State schools of Massachusetts in America, and of the Normal Art College at Boston.

Textile Department.

In the textile department instruction is given in the manufacture of textile fabrics of every description; including the nature and properties of the raw material, and the application of design to woven fabrics. Mr. J. R. Ashenhurst, the instructor, has visited, and gained experience in, some of the important weaving schools in other countries. There are few weaving schools in any country so thoroughly equipped with all the best appliances of instruction, or so largely attended. Nearly 300 students attend these classes; the majority of those who come in

the evening are over-lookers or aspiring workmen, while the day classes are attended by the sons of manufacturers.

Chemistry and dyeing department, Bradford Technical College.

The chemistry and dyeing departments are under the direction of Dr. Knecht, who was trained under Dr. Victor Meyer as an assistant in the chemical laboratory of the Polytechnic at Zurich. The students are grounded in the principles of chemistry, which they apply to the investigation of the properties and uses of the various dyeing materials, by analysis, and by practical experiments in dyeing.

Engineering and machine-making department.

Drawing office.

In the engineering and machine-making department, the theory of the class-room is united with the practical experience of the bench, lathe, and forge. It is doubtful if there is any school workshop in this or any country so well fitted up with modern mechanical tools and appliances. Mr. Dales, the head of the mechanical drawing office, is familiar with the details of mechanical engineering, having devoted his life to the practice of the profession. Under a careful scheme of instruction and under practical workmen, the students become familiar with the various tools used in working in wood and metals.

General science department.

In the general science department there are classes in practical, plane, and solid geometry, mathematics, physics, chemistry, steam, applied mechanics, and machine construction.

Day school.

A special feature of the college is the day school, under the head-mastership of Mr. James Spencer, B.Sc., in which there are 130 pupils whose ages vary from 12 to 17. This department is intended to act as a feeder, preparing students for the technical classes.

Programme of instruction.

The curriculum of the school embraces—

1. The general course, which includes English, mathematics, mechanics, chemistry, physics, drawing (freehand, model, geometrical), and machine construction.
2. Technical course; a pupil upon entering may select one subject from the following: Mechanical engineering, art, pattern-designing, weaving, dyeing.
3. Languages; French, German, and Latin.

The pupils who are studying technological subjects, receive one or two lessons a week from the various specialists, and spend besides, several hours a week in the weaving sheds, the workshops, the dye house, or art rooms, as the case may be. The day students who attend the college for special subjects, such as weaving, dyeing, and engineering, receive instruction if they desire it, with the day pupils in mathematics, physics, French, German, &c.

Scholarships

An important feature in connection with the day school is the scholarship scheme, whereby, from a fund generously subscribed by manufacturers, merchants, and others, about 60 boys of the artizan class from the elementary schools of the town are admitted by competition, and receive two ye[illegible]n in the school, free of charge.

The head-master expects, from an extensive past experience of pupils of this character, that not only will they pass the Government examinations of the Science and Art Department with credit before leaving the school, but that when they become apprentices they will return to the evening classes, and follow the instruction in the special sciences relating to their daily work, with far greater zest and profit than those who have not had the advantage of similar training.

XXII.—KEIGHLEY.

Keighley, Yorkshire.

The Commissioners visited the town of Keighley, in the West Riding of Yorkshire, (population 30,000), for the purpose of inspecting its Elementary and Science and Art Schools, and they also examined some of its leading industries. The worsted manufacture, of which Bradford is the centre, gives employment to the bulk of the population of the town, but Keighley is likewise the seat of numerous mechanical and other industries, employing in the aggregate a large number of workpeople. It is perhaps, best known as the chief seat of the manufacture of long-wool spinning machinery.

School Board.

In elementary education, Keighley has shown considerable activity. In consequence of the opinion that the accommodation was ample, and the instruction efficient, a School Board was not formed until the year 1875. At that time the number of children on the registers amounted to 3,749, with an average attendance of 2,007. In 1883 the number on the registers was 5,829, with an average attendance of 4,051, or more than double the attendance in 1875. The percentage of passes, under the new Code (1883), was 87.

Elementary education.

The Commissioners visited one of the large Elementary Board Schools, with accommodation for 1,000 scholars. This school, like the others erected under the Board, follows the German plan; the so-called class-room system being adopted, in which each class is placed in a room by itself, under a single master; each class-room thus being in effect a separate school, under a duly qualified adult teacher. In the centre of the school is a large central hall in which all the children can be assembled at once. As tested by results, the above arrangement is a satisfactory one, for, while the cost of teaching per head is lower than in the average of the Board schools of the country, the percentage of passes is higher. The sexes are taught together, girls sitting on one side of the room and boys on the other. The most remarkable fact connected with these schools is the success of the half-timers. The Keighley district is essentially a factory district, there being 1,500 factory half-timers attending the schools. Although these children receive less than 14 hours of instruction per week, and are required to attend the factory for 28 hours in addition, their percentage of passes at the examinations is higher than the

average of passes of children receiving double the amount of schooling throughout the country.

Keighley Mechanics' Institute and Schools of Science and Art.

The *Mechanics' Institute and Schools of Science and Art* in Keighley represent the modern development of a Society established in the town in 1825. Its formation was actively promoted by a number of working men, anxious to carry into effect the scheme of Dr. Birkbeck and Lord Brougham. After a few years' occupation of temporary premises, a Mechanics' Institute was erected by public subscription, and for 35 years, by the aid of its lectures, classes, and library, was the chief instrument in promoting the literary and scientific culture of all classes in the town. It is interesting to record that many of the leading employers of the past and present generations have gratefully testified to the fact that to the facilities here afforded they owed almost their entire education.

New building.

The present building, now inadequate for its requirements, was opened in 1870, and, including furnishing and subsequent additions, cost nearly 20,000*l.* A grant of 820*l.* was obtained from the Science and Art Department, on the Science and Art rooms, but, with this exception, the whole outlay was met by the voluntary subscriptions of all classes of inhabitants in the town. In order to obtain experience as to the best methods of imparting a practical education for an industrial community, several members of the Council visited the leading schools of Germany, Switzerland, and Paris, and the information received was utilised in organising the departments of the Institution for day and evening instruction.

Class rooms and laboratories.

The Institution contains (1) a series of class rooms for elementary and science teaching; connected with these a chemical laboratory, room for apparatus and models, lecture theatre, work room and class rooms; (2) a school of art, with rooms for elementary drawing, mechanical and architectural drawing, modelling and designing, a room specially arranged for drawing from models, casts, and from the life, and a picture gallery for the periodical exhibition of the works of the students and the loan collections from South Kensington and other sources; (3) a department, common also to the students of the above, for the pursuit of general information and for the recreation and amusement of members; comprising lecture hall to accommodate 1,200, library (now containing 7,000 volumes), reference library for the benefit of the students; newsroom for daily newspapers and telegrams; reading room for periodicals and magazines; penny bank; conversation and smoking rooms. A large gymnasium was afterwards provided.

Trade and Grammar School.

In the day school (called the Trade and Grammar School), whilst the teaching is so efficient that the leading manufacturers of the district send their sons, the fee for artisans is so low that a considerable number of that class have been attracted to the school, and constitute fully two-thirds of the total students. Thus the sons of employers sit side by side at their studies

with the sons of their workmen, and this result is considered to be mutually satisfactory.

Exhibitions, Keighley.

By the aid of a number of exhibitions from an old grammar school endowment (the Drake and Tonson Exhibitions), the cleverest boys in the elementary schools of the town are yearly admitted by competition into the Trade School; maintenance grants from another endowment (the Bocock Fund) being made to the poorest.

Evening instruction.

With regard to the thousands of boys in the town who pass through the elementary schools, and cannot win exhibitions or enter the school as ordinary students, the Council have provided means whereby they can go through the Trade School curriculum in evening classes. At a nominal fee (one penny per night) students, male and female, may there supplement the instruction of the elementary day school, under certificated teachers.

There are also scholarships admitting students from the elementary classes to the science and art classes.

Evening classes in literary subjects.

There are likewise evening classes in French, German, Latin, shorthand, singing, &c., and in addition, lectures on scientific and literary subjects provided by the Council. It may be worth mentioning that Keighley was one of the first towns to take advantage of the scheme of University Extension instituted by the Syndicate of Cambridge, and classes were conducted and lectures given for three sessions.

Studentships under Science and Art Department.

In addition to the above-mentioned local scholarships and exhibitions, by means of science "studentships," artisan students, by competition with schools and classes in the United Kingdom, are admitted to the Normal School of Science, South Kensington, with their tuition fees paid, and ample allowance made for their maintenance, while in London, by the Department, and travelling expenses to and from their homes. (Since 1872 nearly 50 of such exhibitions have been gained, and two students from Keighley (one having obtained the Doctor of Science degree, and having been raised to the dignity of Professor) have been retained on the teaching staff of the Normal School.)

By means of the "Devonshire" and "Holden" exhibitions, presented respectively by His Grace the Duke of Devonshire and Mr. Isaac Holden, M.P., value 50*l.* each (25*l.* in each case being supplied by the Department), two students are annually admitted to such of the following colleges as they may select, viz., the Yorkshire College, Leeds, the Royal School of Mines, London, the Royal College of Chemistry, London, the Royal College of Science, Dublin.

The deserving poor boy is admitted from the elementary school to the Trade School for two years' tuition, free of cost; he may be retained in the Trade School for two years after his exhibition expires, and has the opportunity of winning further exhibitions to South Kensington, where he receives the highest scientific instruction under the most distinguished professors at the Normal School of Science. These advantages are open to students

in evening classes, and in a great number of instances have been fully enjoyed by them.

Weaving school.

A weaving department has been in operation for four years, and has been generously supported by the Worshipful Cloth-workers' Company of London. There are hand and power looms for experimental work, and other necessary apparatus for weaving. The operations of this department are somewhat cramped for want of space and motive power, but nevertheless a large class of young men, all connected with the textile industries, are receiving systematic instruction in designing and weaving,—in designing a pattern on paper, and working it out in the loom,—it being impossible for them to obtain such instruction in the ordinary factories of the district. Already latent faculties of artistic power have been aroused, and designs have been executed, not only ingenious and original, but of commercial value.

Plans are in course of preparation for extending the building by the addition of a wing for technical workshops, power-looms, &c., and a chemical laboratory and museum. The extension is estimated to cost 5,000*l*., towards which the Clothworkers' Company have generously promised a subscription of 1,000*l*.

Number of students.

With regard to the number of students attending the schools, the last report (1883) states that in the day and evening classes there were nearly 1,100, the great majority of whom were artisans from the machine shops and factories.

Club department of institute.

The strictly educational department of the Institute is separated from the more social or club department, and a separate registration of membership is required for each. Only a small proportion of the ordinary members of the Institute are also students of the classes, yet of the latter class the last Report shows that at present there are over 1,000 persons maintaining their membership of the Institute. These returns show that over 2,000 of the 30,000 inhabitants of the district are directly connected with the Institute.

XXIII.—SALTAIRE.

Saltaire, founded by Sir Titus Salt.

The Commissioners visited Saltaire on the invitation of Mr. Titus Salt, and were conducted by him and Mr. Stead over the various departments of the works. Although it is 30 years since these factories were built, and the town and its several institutions were founded and planned by the late Sir Titus Salt, yet, whether considered in relation to the arrangements of the factories, or the extensive provision for the education, health, and recreation of its people, the town of Saltaire is probably the most remarkable and most complete industrial colony that has been founded in any country.

We refrain, as in the case of all other English visits, from describing the factory, much as we are tempted to do so.

Saltaire cottages. The town consists of 850 houses and cottages, with a separate yard to each, let at rentals varying from 2*s.* 6*d.* to 12*s.* per week. There are about 40 shops, and large co-operative stores for supplying the population with food, clothing, and other requirements. There is no public-house in the town.

Baths. In a convenient and central situation are the baths and wash-houses with two plunge baths, 24 slipper baths, and Turkish and douche baths. The washing department is furnished with steam tubs, with a plentiful supply of hot and cold water, drying closets, and all other requisites.

Schools. For supplying the educational wants of the neighbourhood, there are two elementary schools, attended by 850 children each. The provision for secondary education was made at the sole expense of Sir Titus Salt, in the form of "High Schools" for boys and girls. The schools for girls were erected in 1867, at a cost of 8,000*l.*, and were first used as factory schools; the department for boys is conducted in the rooms of the Saltaire Institute. These High Schools were incorporated by the Charity Commissioners in 1877, under the title of "the Governors of the Salt Schools, Shipley, 'Registered.'" The numbers, at present attending, are 68 boys and 160 girls.

Club and Institute. The Saltaire Club and Institute was erected by Sir Titus Salt in 1871, at a cost of 30,000*l.* In addition to a handsome lecture-hall, with accommodation for 1,500 persons, there is an extensive library, a spacious reading room, chemical laboratory, a number of class-rooms for science, a well equipped school of art, a gymnasium, and a large billiard room.

In the winter, courses of lectures, concerts, "social evenings," and conversazione are provided for the instruction and amusement of the public. The institute numbers 800 members.

Public park. There is a well kept park of 14 acres, beautifully situated on the banks of the river Aire, and skirting the woods of Shipley Glen, one of the most picturesque and favourite resorts in the district.

Dining hall. A public dining hall has been erected in connection with the works, in which 1,000 dinners can be served in a few minutes. The meals range in price from two-pence upwards.

Almshouses. A group of alms houses, and Sir Titus Salt's Hospital, have been erected for the aged and infirm, and for the sufferers from accidents. The hospital contains three wards (nine beds) and an out-patients' department. The almshouses for the aged poor have been endowed with 30,000*l.*

Places of worship. Of places of worship, there are the Saltaire Congregational Church, erected by Sir Titus Salt at a cost of 15,000*l.* In a mausoleum attached to this church, the honoured founder of this church is buried. The Sunday school connected with this church cost 10,000*l.*, and has accommodation for 800 children in 24 class-rooms and a large hall. There is a Wesleyan chapel erected at a cost of 5,400*l.*, and a Sunday school attached, with accommodation for 800 children in 20 class-rooms and a large hall.

Sunday schools.

Among the numerous associations are two or three benefit societies, a funeral brief, women's sick relief society, cricket club, angling association, brass band, string and reed band, choral society, fire brigade, &c. Saltaire local societies and clubs.

Under the guidance of Mr. Titus Salt, we visited the elementary schools which are under the Shipley School Board, of which he is chairman. The Albert Road School is built on the separate class-room system, with an assembly-room in the centre. The infant department is in the same form, and all the details of arrangement and furnishing have been carried out with the greatest care and forethought by Mr. Salt, who has made the question of school buildings and furniture a special study, both in this country and in America. The exceptional feature of these schools is that the classes are mixed, and all taught by females. The numerous half-timers are taught in classes apart from the other children, and were stated to be about two standards behind the children of the same age who had passed all their time at school. The rough factory boys attend the school, and yet the discipline is excellent, while the educational results are satisfactory both as to half-and full-timers. The infant schools are taught on the Kindergarten system, by thoroughly efficient and enthusiastic teachers Some of the modelling in clay by the infants was excellent, and the plaiting of coloured strips of paper, and the making of designs on ruled paper with coloured worsted, showed evidences of more than ordinary ingenuity. Saltaire Board schools. Infant schools.

XXIV.—NOTTINGHAM.

The Commissioners were met by the Mayor, Mr. Lindley, and the chairman of the School Board, Mr. Alderman Gripper, who accompanied them to the People's College. This school was erected in 1846, by voluntary contributions, for the education of the working classes. It has now been taken over by the School Board and extensively remodelled for its present purpose, to serve as a higher grade board school. The buildings are in two separate divisions and are intended to accommodate 480 boys and 300 girls. The fees are 9*d.* per week, but children leaving other board schools after having attained the fifth standard, are admitted for 6*d.* per week. The cost of the school has been about 10*l.* per child for the 780 children. The class rooms are large and well arranged, consisting of one long room on each floor, divided into separate spaces, each accommodating 60 children, by glazed sliding screens. The whole school is heated by hot water. The woodwork is of polished pine and the walls are coloured French grey; the rooms being surrounded by a buff-coloured enamelled tile dado. Nottingham "People's College," a higher elementary school.

One of the class rooms is about to be converted into a chemical laboratory which will contain 38 working places, two smaller rooms Chemical laboratory.

Nottingham.

being screened off at one end for a balance room and operation room. The cost of fitting up this laboratory, exclusive of apparatus and re-agents, is estimated at 310*l.* By means of the sliding screen the adjoining class room can be used for demonstrations before a large class.

The head-master of the school, Mr. Edward Francis, informed the Commissioners that at the present time the fourth standard is the strongest section. They eventually intend to make five classes, equivalent to the fourth, fifth, sixth, seventh, under the new code, and a so-called eighth standard, the last-named, however, not being recognised by the code. The boys in this school would come at 10 or 11 years of age and remain till 15 or 16.

Attention paid to drawing at People's College.

A feature in this school is the large amount of time devoted to drawing, the whole of Friday afternoon being allotted to this subject.

The playground is small, and there is no provision for gymnastics, which are not appreciated in the town.

Huntingdon Street Board School.

The Commissioners next visited the Huntingdon Street Board School, which has 480 children, under Mr. Edward W. Hemming, the head-master, six assistant masters, and two ex-pupil teachers. The pupil teachers in the Nottingham schools are not counted as teachers until the third or fourth year.

The class-rooms are about 22 feet wide, lighted from the front and back, and divided off into long rooms by means of glazed partitions, portions of which are hinged as doors, and capable of being opened at an angle so as to give uninterrupted communication from one room into another to the master. The partitions cost about 40*l.* each.

Some of the Commissioners visited a mixed half-time school.

The Commissioners were informed that the passes in Nottingham for half-timers are about 82 per cent. as against 87 per cent. in whole-time schools. The average attendance in this, which is a full-time school, would be 85 per cent. of those on the register, with 96 per cent. of passes.

The class under instruction by the head-master, which contained two standards mixed, consisted of 80 boys.

Nottingham University College.

Nottingham University College.—The college buildings were erected at a cost of 70,000*l.*, of which 10,000*l.* were offered by an anonymous donor on the condition that the buildings to be provided by the Corporation of Nottingham should include a lecture room, capable of seating 400 persons. The Town Council accepted this offer, and it was resolved to erect at once a group of buildings that should provide for the University Extension, scientific, and other higher teaching of the town, and at the same

time furnish accommodation for the Free Library and the Natural History Museum. The 60,000*l.* granted by the Corporation was taken from funds they possessed, to be devoted to the general welfare of the town. The college was opened on the 30th June 1881, by H.R.H. the late Duke of Albany. For its maintenance, the Corporation grants 4,000*l.* annually, derived from various sources, whilst the college has a revenue of 3,000*l.* a year from charitable bequests, these sums being supplemented by the students' fees. There are numerous rooms for the various classes, an excellent lecture theatre for physics, and another for chemistry, a physical laboratory and workshops, a large chemical laboratory with 60 working places, and a public lecture theatre, in which popular lectures are given each week, the admission to which is one penny per person. The building is a very handsome structure, admirably adapted in every way for its intended uses. Nottingham University College.

There are four professors; viz., of mathematics and physics, chemistry, natural history, and literature, and they are aided by science teachers and University Extension lecturers. Teaching staff.

The constitution of the college is as follows:—It is governed by a committee elected annually by the Town Council, twelve from amongst their own body, and seven members not councillors. In consequence of the somewhat unwieldy nature of this committee, it is in contemplation to elect standing sub-committees to arrange the general business, and to report to the governing body, who would then meet only at rarer intervals. The four professors constitute a species of informal senate, or studies sub-committee, to arange academical work, and report to the general committee. Government of the college.

Professor Garnett stated that at the time he came to Nottingham, the college was already at work, the first year having been devoted to subjects of general literature, and the audiences attracted could not be considered bonâ fide students. His effort had been to differentiate more clearly the teaching for artizans and the regular university day students' work. The latter were going in for the Intermediate B.A. degree or the Arts degree of the London University. In order to attract students, he had been willing to start classes even for a single individual. Thus at first he had one or two working for the 1st B.Sc., one for the Cambridge B.A., &c. His day classes, which represent his higher teaching, were as follows:—Electricity, with about 7 students; mechanics, with 10 students; elementary mathematics, with 30 students; intermediate arts (London University), 3 students; intermediate science, 1 student. There were also day classes in literature and history, natural science, and chemistry. Among his evening classes was that of elementary mathematics, with 10 students, theoretical mechanics, with 4 students, electricity, with 40 students, and an advanced lecture class of 15 students. In addition to the classes directly connected with the college, were those connected with t' and Art Department, which were taught by master Professor Garnett on the Nottingham College.

Nottingham University College.

by South Kensington, which classes were also under his general supervision. Some of these classes were in the same subjects as the college classes, such as magnetism, electricity, &c. Asked if he could point out the difference between the teaching of these subjects in these parallel classes, he stated that there was a great difference in degree between the manner in which a Cambridge man would teach and the instruction given by an ordinary science master. On being pressed to state more clearly what this difference was, he said that generally in the South Kensington text books, if the teacher came to a difficulty, it was shirked or escaped. If a Cambridge lecturer came to a difficulty, it would be at once pointed out and either solved or an attempt made to solve it. It would not be set aside. The conversation turning to the University Extension lectures, he said that these lectures are undoubtedly supplying an acknowledged want. He might mention as an example that he had lately before him the work of 150 candidates in electricity and magnetism, from a group of towns in the north of England, who had been wonderfully well taught by a college man; the plan of teaching was by lectures alternating with meetings for the answering of questions given out at the lectures and prepared in the interval; this system worked well. He considered the South Kensington classes were not nearly so well taught as those under the Extension scheme. Twenty-two papers received from Middlesborough, chiefly by working-men, were excellent. He admitted that the absence of practical teaching was a defect in the University Extension classes, and that electricity could scarcely be taught thoroughly without such practical work, but pointed out that this defect was shared by the South Kensington science classes.

Nottingham School of Art.

Nottingham School of Art.—A visit was also paid to the Nottingham School of Art, situated in a fine building in the centre of the town, and erected by public subscription. The Commissioners were received by Mr. T. J. Birkin, the chairman, and several members of the committee, who, together with Mr. T. J. Dalgliesh, the head-master, accompanied them over the school. The income of the school from the fees in the morning and evening classes amounts to about 625*l.* a year, the total number of students on the books being about 650. An interesting feature is the recent erection, at a cost of 1,000*l.*, of a large conservatory, or plant-form studio, covering an area of 2,520 square feet. The art work of the school has had an important bearing on the trade of Nottingham, and the designers trained in the school have been largely employed in the leading manufacture of Nottingham, that of lace. Considerable success has always been obtained in the national art competitions, by the students of the Nottingham School. The Commissioners were present at a lecture on geometry, which was well attended, and they also visited the designing class, life class, &c.

Income.

The Commissioners visited the Art Museum, situated in Nottingham Castle, where they were received by Sir J. Oldknow, the chairman, and Mr. G. Wallis, the curator. The ruins of Nottingham Castle were restored, and adapted for the purpose of this museum, at a cost to the Corporation of nearly 30,000*l.*, and the collections were opened by their Royal Highnesses the Prince and Princess of Wales in July 1878. The galleries are admirably fitted for their purpose, and contain very fine collections of pictures and other objects of art, most of them on loan from their owners in the neighbourhood; a large number of objects contributed by the South Kensington Museum; and a general collection of specimens of decorative art. The museum is open to the public on five days in the week on a payment of 1*d.* on Mondays and Saturdays and 6*d.* on other days, whilst one day per week is reserved for students. The total admissions during the last financial year were 223,000 persons, over 121,000 being admitted by single payments, and 101,000 by season ticket, the receipts for the 12 months amounting to 1,720*l.* Annual exhibitions of pictures, by local artists, are held in this museum. Prizes are offered for freehand and mechanical drawing. The collections of lace, which are now being made by the curator, will, it is anticipated, be of great value to the designers for local manufactures..

Nottingham Art Museum.

Admissions.

Visits to Lace and other Manufactories.—Visits were paid to various manufactories of lace, of tools, and of lace-making machinery, and to extensive hosiery works. The staple trade of the town was well seen by an inspection, kindly afforded to the Commissioners, of one of the great warehouses. Here not only are the laces and curtains passed through the last stage of their preparation before going to the wholesale houses in London, but a staff of designers is employed in producing original designs for curtains and lace. The proprietor explained to the Commissioners the way in which these designs are prepared, and stated that, in his opinion, very many less lace designs are now being purchased from abroad than was formerly the case.

Visits to lace and other manufactories.

XXV.—Bristol.

Bristol Trade and Mining School.—The Commissioners visited the Trade School, now known under the name of the Merchant Venturers' School. The establishment of this school was mainly due to the efforts of Canon Mosely, who reorganised a British school, which had been closed for some years, as a school for teaching applied science. It has lately been placed under the Merchant Company of Bristol, who administer the Colston Trust Fund. A new school building, to accommodate 500 pupils, is being erected by the Company, and this, when completed, will absorb the present trade and mining schools, under the title above. The present building is antiquated, overcrowded, and ill adapted to its purpose.

Trade School, Bristol.

Bristol Merchant Venturers' School.

The school is practically in four divisions. (A.) An elementary division called the primary department for boys not under nine years of age; this is merely an ordinary elementary school, in which, however, the rudiments of French are taught. (B.) A secondary department which receives lads up to 18 years of age. After the third year the instruction bifurcates into, (C1) a division for the study of mathematics and the applied sciences, intended to prepare boys for a career connected with manufactures and the constructive arts, and, (C 2) a department for studies suitable for those to be engaged in commercial life.

Mining and engineering.

There is further a higher grade mining school (D) for the study of mining and engineering, with a two years' course.

The energetic master, Mr. Comber, has been most successful in teaching science subjects under the Science and Art Department. All the boys learn drawing, and both in this subject and in science the school earns a high grant. In the lower classes of the secondary school there is no practical laboratory work, and in the mining school, which has about 17 students, chemistry and field-work are the only subjects in which practical work is done. The entire school has 280 pupils. In connection with it are night classes for drawing and various science subjects, and also for Latin and French.

Number of pupils.

Fees.

The fees in the day school are 1*l.* 6*s.* 8*d.* per term (three terms in the year, with an entrance fee of 7*s.* 6*d.*). In the mining school the fees are 5*l.* 5*s.* per term, with an entrance fee of 12*s.* 6*d.* For the night classes the fees are for French and Latin 10*s.* 6*d.* the session, and for science subjects 7*s.* 6*d.* for one, 10*s.* 6*d.* for two, and 7*s.* 6*d.* for each additional subject.

Laboratory.

The school possesses a fairly well equipped laboratory, in which special students are admitted to work for 21*l.* per annum, and night students pay a fee of 1*l.* 1*s.* per session for laboratory practice.

University College.

University College, Bristol.—The college is situated in the upper part of the town, in new buildings, which are only partially completed. It was opened in 1876. The total annual expenditure is about 4,400*l.* The fees of the students produce 2,150*l.*, subscriptions, local, 1,400*l.*, Clothworkers' Company, London, 300*l.*, Balliol College, Oxford, 250*l.*, and miscellaneous receipts 100*l.*, leaving about 200*l.* unprovided for. We were received by Professor Ramsay, the principal, who directs the chemical department, and were conducted by him over the various class-rooms.

Laboratory.

The chemical laboratory is large and well-fitted, and contains 24 working places, but there is room for additional tables. In order to provide for the present number of students, the places have to be duplicated. There is a small balance room and a professor's private laboratory. Upstairs is a convenient lecture theatre and preparation room, a store-room for chemical apparatus, a class-room for physiology, and a small physiological laboratory. In the engineering drawing room, which is very

small, about 16 students can work at a time. The lecturer on mechanics showed us his workshop, in which only two or three students can attend at one time. There are a lathe, and a couple of vices; some brass turning and tool handles were shown to us, the work of the students. In the lecture room a class of five students were taking notes of a problem in geometry which was being explained by Mr. H. H. Shaw. Professor Sylvanus Thompson, who undertakes the physical work, has two laboratories, one of which is mainly used for electrical work, and the other for experiments in light and heat. The sum of 300*l.* has just been subscribed for apparatus urgently needed to equip this department, and some excellent instruments from the Cambridge Scientific Company were shown to us. There are in all about 180 day students, among whom are many ladies. The larger proportion of the students are attending the classes in literature and modern languages. About 70 students are going through a complete and systematic course suitable for students of applied science. There is a medical school attached to the college.

Workshop.

Physics.

XXVI.—Bedford.

At the invitation of Mr. James Howard, M.P., the Commissioners visited Bedford, in order to inspect the Grammar School, the Modern School, and the elementary schools. All these schools are endowed from an ancient foundation, the Harpur Trust, which has a revenue of about 15,000*l.* a-year, arising from large estates in London.

Bedford schools.

The first visit was to the Grammar School, which may be regarded as the classical side of the institution. The two schools are distinct, and are carried on in separate and non-adjacent buildings. In the Grammar School the commencement of practical work is made in the shape of small shops for carvers and fitters, but they do little more than furnish recreation for the boys during a portion of their play time. In the Modern School practical instruction is given both in chemistry and in physics, and it is in contemplation to erect workshops for instruction in the use of tools.

Grammar school.

Practical work.

Modern school.

A large and handsome school has also been recently built under this charity as a Girls' High School.

The Grammar School is under the head-mastership of Mr. J. Surtees Phillpotts, M.A., B.C.L., with a staff of 22 assistants. The head-master of the Modern School is the Rev. Robert B. Poole, B.D., and he is assisted by a staff of 25 masters and instructors.

Staff of Grammar school and modern school.

The fees in the Grammar School are 3*l.* or 4*l.* per term (according as the scholar is under or above 13), and in the Modern School 1*l.* 6*s.* 8*d.*, 2*l.*, or 3*l.*, as the scholar is under or above 16, or

Fees.

above 17. There are three terms in the year. There is an entrance fee of 2*l.* in the Grammar School, and 1*l.* in the Modern School. The scheme of the charity was settled under date of the 4th August 1873, and a printed copy of the scheme was handed to the Commissioners. It provides for the carrying on of the trust by means of governors, for the management of the schools for boys, girls, and infants, and of the large charities to which a considerable portion of the money is devoted.

The Bedford Schools are so excellent and the fees are so low that many people with small means are being attracted to the town in order to obtain, as residents, the education for their children supplied by this charity, which embraces free elementary as well as the above-mentioned higher schools.

Harpur Trust Funds, Bedford.

The net revenue of the Harpur Trust Funds for the year 1881 consisted of 14,754*l.* Out of this amount $\frac{4}{11}$ths were devoted to the Grammar School (= 4,599*l.*): $\frac{4}{11}$ths to the Modern School (=4,599*l.*); $\frac{2}{11}$ths to the Elementary School (=2,300*l.*); and $\frac{1}{11}$th for eleemosynary purposes (= 1,150*l.*), being a total of 12,648*l.*, and the balance being absorbed in the general and office expenses.

XXVII.—KENDAL.

Visit to Kendal.

History of Kendal Industries.

The town of Kendal, (population 13,696 in 1881), as being representative of one of the more ancient seats of industry, was visited by the Commissioners on the invitation of some of the leading inhabitants. It is one of the cradles of the English woollen industry, and was developed as far back as the year 1337, by Flemings, who brought with them from the Low Countries the skill in weaving and the knowledge of dyeing for which at that time they were famous. In those days England was a pastoral country, and exported large quantities of wool to Flanders, France, and Germany, where the wool was made into cloth, of which a fair proportion was exported back to England. The historian of the time recorded that "the ribs of people "throughout the world are kept warm by the fleeces of English "wool." On one occasion when the export of wool from England was prohibited, the effect upon the manufacturing population of the Low Counties was disastrous, and reduced many to despair and destitution; and when England thus lost some of its markets for wool, the distressed Flemish artizans were invited to settle here, and as above stated, several found their way to Kendal. For many generations, Kendal, under the influence of the Flemings, became famous for the manufacture of woollens, and of "Kendal Green" buckram. In more modern days, Kendal, like many other historic towns, has had to bow

before the greater enterprise and spirit of younger towns, in other parts of the country.

Kendal Industrial establishments.

The Commissioners visited some important woollen and carpet manufactories and works for making "cards," "reeds," and "healds" for the woollen industry.

At one of the works which we visited, the designer was from Scotland; at another, a designer from Kidderminster had taken the place of one educated at South Kensington. The heads of two of the firms had studied chemistry, but among the workmen there is no chemical knowledge. By long experience, excellence has been attained in dyeing, and in the case of one family, three generations, grandfather, father, and son, have been famous for proficiency in a certain colour.

Schools of Kendal.

The schools of Kendal are numerous, and education is well administered. In addition to thirteen elementary denominational schools and secondary girls' schools, there is a grammar school founded in 1525, attended by from 40 to 50 boys; a Blue Coat (charity) school, 45 boys; a commercial school, 50 to 60 boys; and a Friend's school, 50 to 60 boys.

The schools of science and art, united in one building, were visited by the Commissioners. In art there are 50 students, of whom 14 are females. The science classes are attended by a total of 130 pupils.

Literary and Scientific Institution.

The Kendal Literary and Scientific Institution is a society of 172 members, having its head quarters at the Museum, and through an educational committee, promoting the education of the town, and providing lectures of a popular and scientific character. Last year there were seven such lectures given, in addition to a course of Cambridge University lectures on physical geography, attended by about 140 persons.

Mechanics' Institute.

The Mechanics' Institute has 130 members, a reading room, and a library of 7,500 volumes. Musical entertainments are given in the winter months, and classes are held in singing and French.

Christian and Literary Institute.

The Christian and Literary Institute has a reading room and library, and organises a few lectures in the winter, and a railway excursion in the summer. The classes connected with the Young Men's Christian Association are attended by about 60 artizans in the winter evenings. A Working Men's Institute has also a library and reading room well supplied with newspapers and periodicals.

Working Men's Institute.

We were informed that at present 10 students holding scholarships from Kendal schools are atte[illegible] Universities, and some of the students from the scie[illegible]ols are holding high industrial positions in large

XXVIII.—Glasgow.

Glasgow School Board.

Glasgow School Board.—The Commissioners visited the offices of the School Board in Bath Street, and discussed with some of the leading members, the work bearing on the subject of their inquiry carried on under the School Board. One of the differences between the English and Scotch Education Acts is, that in the case of Scotland the jurisdiction of the Board extends to certain secondary and higher grade schools. In Glasgow the High School, which answers to an English Grammar School, is conducted under the Board, though it is not in any way supported by the rates. Mr. Kennedy, the clerk of the Board, kindly furnished us with the following particulars:—

Day schools under the Board.

No. of day schools under the Board	49
Total accommodation of schools opened	38,173
Average number of scholars on roll	41,362
" " " in attendance	33,587

Total number of teachers.—Masters, 197; mistresses, 196; ex-pupil teachers, 37; pupil teachers, 238; monitors, 31. Total, 699.

Evening schools.

In 24 evening schools there were 7,850 scholars, taught by 121 masters and 42 mistresses.

Passes, and grant.

The average passes in all the Glasgow schools in 1881–2 were,—reading 95 per cent., writing 94·6, arithmetic 91·6, or a gross average of 93·7, which is 5 per cent. higher than the average of Scotch passes. In specific subjects 10,094 were presented and 7,984 passed. The grants from the Scotch Education Department were 18*s.* 3*d.* per scholar. Drawing is taught in 41 day schools, and 10,852 children were presented for examination in 1882. The industrial teaching is confined to cookery and needlework for the girls; courses on cookery were given in 12 of the day schools.

The School Board rate is 4½*d.*; a penny rate produces about 10,000*l.*

Evening classes under Board.

The evening classes under the Board are mainly literary.

They are classified as, ordinary	21
advanced	3
	24

Of the total of 7,850 evening scholars, 4,599 were in ordinary branches, 2,979 in special and advanced classes, and 272 in science classes. The students were—

Boys	4,816
Men	1,215
Girls	1,819
	7,850

The subjects of the advanced classes were as follow:— Advanced Evening classes in Glasgow.

French	430
Mathematics	441
Latin	100
Greek	28
Drawing	486
English grammar and composition	233
Writing and book-keeping	331
Elocution	54
Shorthand	235
German	103
Music	88
Cookery	450
Total	2,979 students.

Of the advanced students, 861 youths attended the evening classes at the High School, 751 at the City School, and 267 young women were instructed at Woodside School.

In Science and Art classes in evening schools there were, in art subjects, 486 students in 8 classes; mathematics, 441 in 10 classes. Science classes were conducted in seven subjects, magnetism and electricity, acoustics, physiology, chemistry, machine construction and drawing, building construction, and geometry, with a total of 272 students.

Drawing classes for pupil teachers, conducted by the Board, were attended by 85 boys and 244 girls.

We visited the *Garnethill School*, one of the best under the Board, with 1,000 children in attendance. The fees are 4*d*., 5*d*., and 7½*d*. per week in the elementary division and 1*s*. 0½*d*. in the secondary school. The classes are mixed—boys on one side and girls on the other. Many people of the lower middle classes send their children to the Board Schools. In the highest class about 25 per cent. of the children were over 15, and nearly as many between 14 and 15 years of age. There were 134 in the sixth standard, and 230 children above the sixth standard. The cost of this school was stated to have been 12*l*. per head, without the land. Garnethill Board School.

The *John Street Public School* was also visited by the Commissioners. It is held in a very handsome building, with large playground, partly covered. The cost was 10*l*. per head, without the land. The accommodation, based on 8 square feet for infants and 10 square feet each for the elder children, is for 1,150. There was a very well conducted infant school with 320 children. The hours of attendance and fees are as follows:— John Street Board School.

		Fees per quarter.
Infants	9.30 to 12.0 and 1 to 3.	4*s*.
Junior department	9.30 to 12.15 „ 1 to 4.	5*s*. & 6*s*.
Intermediate department	„ „ „	6*s*. & 7*s*.
Senior department	„ „ „	8*s*. &
Advanced class	9.0 to 12.0 „ „	10*s*.

Glasgow High School.

As an example of a Higher Class Public School under a School Board, we inspected the *Glasgow High School*, one of the 11 schools of this type originally constituted under the Education Act of 1872. The school is divided into a junior and senior section; the former adapted for boys under 10 or 11 years of age, and preparatory for the senior section. During the earlier stages the instruction in the senior section is uniform, but as it advances the pupils branch off into the classical, or the modern side. Dr. Paton, the rector, accompanied us over the school, and we saw the teaching in progress in science and art, the subjects more particularly of interest to us. The study of Natural Science forms a part of the course from the first to the third Form of the senior division, and thence throughout the whole of the modern side of the school. Out of a total number enrolled of 762, with an average attendance of 710, 323 boys learn drawing and 223 science.

Science teaching in High School.

Mr. Muir, the science master, furnished us with the following particulars respecting the science subjects taught and the numbers under instruction:—

1st form	Physical geography	1 hour per week	94 pupils in 2 classes.	
2nd „	Chemistry	2 hours „	78 „ „	
3rd „	Physics	2 „ „	28 „ „	
4th* „	Theoretical mechanics	2 „ „	44 „ „	

By this arrangement of the teaching, all the boys passing through the school obtain instruction in the above subjects in the order described. In the 3rd form, however, it is only those boys who take French instead of Greek who are able to attend the science class, and even this depends on their proficiency in arithmetic.

	Per quarter.
The fees payable in the junior section vary from	15*s.* to 30*s.*
„ „ senior lower form „	45*s.* to 55*s.*
„ „ „ upper „ „	3*l.* to 3*l.* 10*s.*

Glasgow School of Art.

The Glasgow School of Art and Haldane Academy.—This school was established as a Government School of Design in 1842, and is in connection with the Science and Art Department. During the past year it was attended by 869 students, of whom over 600 were of the industrial classes. These latter students pay fees of from 8*s.* to 9*s.* per quarter. The programme is in strict accordance with the South Kensington system, and includes, besides the Art School, science classes in five subjects. During the year 1881–2 the amount received in fees was 1,375*l.* 9*s.* 3*d.*, and the grants earned from the Department were 575*l.* 16*s.* 9*d.* The school authorities complained greatly of the action of the School Board, who had established art night classes at low fees, taught by masters having only second grade

* The 4th form on the Modern Side.

certificates, and who were alienating many of the students from the School of Art. A proposal is under discussion for the erection of a Central School of Art, on land in the vicinity, at a cost of 30,000*l.* Under the guidance of Mr. Simmonds, the head-master, the Commissioners inspected the school and examined the works of the students.

Proposed central School of Art.

Science and Art Classes.—The following list shows the attendance at the various science and art classes in the Glasgow district, as also the subjects taught. Some of these classes are conducted under the School Board, and others in connection with the School of Art:—

Science and Art classes in Glasgow.

Science and Art Classes, 1882.

Number of classes		35
Number of individual students under instruction:—		
Science	2,661	
Art	1,312	
		3,973
Number enrolled for examination:—		
Science	3,362	
Art	1,402	
		4,764
Number examined:—		
Science	2,693	
Art	1,157	
		3,850

The following are the numbers enrolled for examination in each subject:—

Art. —	2nd grade	1,360
	Advanced art	12
	Art Class Teachers	30
Science.—	Practical, Plane, and Solid Geometry	294
	Machine Construction and Drawing	362
	Building Construction	113
	Naval Architecture	30
	Mathematics	462
	Theoretical Mechanics	222
	Applied Mechanics	164
	Sound, Light, and Heat	142
	Magnetism and Electricity	442
	Inorganic Chemistry (theoretical)	343
	„ „ (practical)	233
	Organic Chemistry (theoretical)	41
	„ „ (practical)	16
	Biology	4
	Principles of Mining	8

Metallurgy (theoretical)	1
Navigation	2
Nautical Astronomy	1
Steam	167
Physiography	22
Principles of Agriculture	17
Geology	69
Mineralogy	1
Animal Physiology	148
Elementary Botany	58
	4,764

Allen Glen's Institution, Glasgow.

The Allan Glen's Institution.—The Commissioners also visited the Allan Glen's Institution, which was established in 1853 for gratuitous elementary education; but, in 1876, the trustees obtained a special Act for providing, in addition, a school in which, at a moderate fee, the benefits of a good secondary and technical education shall be placed within the reach of middle class boys intended for industrial, manufacturing, and mercantile pursuits. In this school little or no Latin is taught, and, in addition to ordinary literary instruction, lessons are given in theoretical and practical science.

Workshop instruction, Glasgow.

An especial feature of the school is workshop instruction in the use of tools. The school is divided into three departments: 1st., the elementary, consisting of three classes; 2nd, a secondary, also consisting of three classes, giving both literary and science training; and 3rd, a technical department, in which the science subjects in the advanced stage are taken together with practical exercises in the use of tools. A period of two years is devoted to this workshop instruction, and, according to the head-master, Mr. Dixon, with very satisfactory results. He stated that the manual instruction is equivalent to that which the boys would receive in the first two years of their apprenticeship to an engineer; with the advantage that they also obtain a knowledge of theoretical principles.

Fees.

The fees vary according to the department. In the elementary section about 10*s.* a quarter, in the secondary about 20*s.*; in the technical department 4*l.* 4*s.* per half year. The endowment is valued at 23,000*l.*, and there are 100 exhibitions of from 5*l.* to 10*l.* each. The total number of boys was 371, of whom 42 passed through the technical course, including laboratory and workshops. The time spent in the workshops varies from four to five hours per week. We noticed that the arrangements for teaching practical chemistry were excellent. The grant earned from the Science and Art Department in 1881–2 was 640*l.* 12*s.*, and the amount received in fees was 658*l.*, the whole of which is divided amongst the teachers.

Practical chemistry.

This, the Commissioners were informed, is the only day school in which science teaching was on an altogether satisfactory footing in Scotland; and we consider that it is one of the very best examples of a secondary technical school (except as to the buildings, which are poor) that we have met with in the course of our investigations.

Glasgow College of Science and Art.

The Glasgow College of Science and Art.—This institution is one of the most important of the kind in the country for the evening instruction of artizans, foremen, and others in science and applied art. It was founded in 1823, as one of the results of the movement then inaugurated by Dr. Birkbeck and Lord Brougham. Up to the year 1880 the original constitution, which was practically that of a Mechanics' Institute, remained in force. At that time a new governing body was formed, and the institution was placed on its present improved basis. The building is well adapted to its purpose, and contains numerous class-rooms, two chemical laboratories, a physical laboratory, and lecture-room, and a number ot rooms for technical workshops, practical instruction in dyeing, &c.; also a large lending library. Diplomas in engineering, science, and chemistry, are given to those who pass through a regular course, and a similar diploma for naval architecture is about to be granted. The total number of day and evening students was 758.* A prominent feature in this technical college is that all the lecturers in applied science and technical subjects have served their apprenticeship to, and been for a considerable time practically engaged in the trade or profession with which the subject is most closely connected.

At present there is no fixed endowment; the income is made up of a grant from Hutcheson's Hospital of 600*l.*, annual subscriptions about 40*l.*, grant from the Science and Art Department (1882), 445*l.* 10*s.*, from the City and Guilds of London Institute 51*l.*, and the fees. The annual expenditure of the college is about 2,000*l.* The day classes are almost entirely attended by engineers.

Anderson's College, Glasgow.

Anderson's College, Glasgow.—This institution, which is a science and technical college, was founded by John Anderson, M.A., F.R.S., who died in 1796, and left a small sum for carrying out the very large scheme devised in his will. Connected with it is also a medical school. The professor of physics and mathematics, is Mr. J. Blyth, and that of chemistry is Mr. W. Dittmar, F.R.S.

The "Young" chair.

A chair of technical chemistry was founded in 1876 by Dr. Jas. Young, F.R.S.; the director of this department is Dr. Mills, F.R.S. Practical instruction, in theoretical and applied chemistry and in physics, is given by the professors in the various labora-

* We see by the class lists for November 1883 that these numbers have been considerably exceeded.

tories, and some of the analysts and skilled foremen in the important chemical works in the district have gone through a course of instruction in this institution.

Course of instruction, Anderson's Charity.

The technological evening classes form an important feature of the institution, and include most of the science subjects found in the syllabus of the Science and Art Department. No less than 1,219 students attended these classes in 1882. It is interesting to note that the names of Graham and Penny are on the list of former professors of chemistry in this institution, whilst those of Livingstone, Young, and Playfair will be found amongst the former students.

Research laboratories.

A unique feature of the technological chemistry department is the existence of several special private laboratories which may be hired at a low rental by those desirous of conducting original research.

The total number of students in all the classes is 2,517. In the Appendix will be found an account of the courses of the two departments of chemistry.

Glasgow Weaving School.

The Glasgow Weaving School is under the management of a board of trustees, Mr. D. Sandeman being the convener. The instructor is Mr. James Macaulay. The teaching is given both during the day and evening. The fees for the day classes are 6*l.* 6*s.* per annum, and for the evening classes 4*l.* 4*s.* There are in all 58 students. The session lasts from 1st September to the 31st of May. The hours are 10 to 12 a.m. on three days per week for the initiatory course, and the advanced course meets on the afternoons of the same days from 12 to 2 p.m. The evening instruction is given twice a week from 7 to 9 p.m.

Nature of the instruction.

The instruction is both theoretical and practical. At the time of our visit a lecture was being given in the theatre upstairs on the weaving of cloth, with diagrams and blackboard sketches.

Looms, &c.

In the weaving room are 15 power-looms and 11 hand-looms, six of the latter being small pattern-looms; also card-cutting machines, winders, &c. The diploma of the school, woven in silk and involving the use of 6,000 cards, was handed to us.

The course of practical instruction includes plain and figured weaving in its initiatory and advanced stages, on hand and power looms, drafting, and cording of various fabrics, viz.:—

Plain cloths with single and double twilling, flushing, dicing, diaper, spotting, &c., double cloths backed with weft, and also backed with warp and weft, &c.

Cross weaving, comprising half and full gauze, harness gauze, net and plain, net and gauze, and wheel lappet.

Piled fabrics, viz.:—

Terry velvet, cut velvet, velveteen, corduroy, &c.

Jacquard machine and harness work, in carpet, damask, double damask, and brocade do., striped all over, and covered, in shawls, scarfs, cloakings, vestings, &c.

Instruction is also given in winding, warping, beaming, and reeddling.

Designing forms an important part of the instruction, including original patterns on point paper, and coloured to indicate the woven fabric, in figured, plain, and twill cloths, &c. Designing.

Various methods of experimenting with hand-looms are taught, additional apparatus for this purpose having been obtained, and facilities are provided to enable students to acquire a thorough knowledge of the construction of power-looms.

The analysis of woven fabrics is likewise taught—the method of ascertaining warp and weft quantities and grists, the calculation of the cost of goods, &c.

We were informed that a student attending the school for a two years' course of instruction would be competent to take a picture, cut cards for it, put it in the loom, weave it, and calculate its cost.

Glasgow University.—Although passing somewhat beyond the special sphere of our report, we must refer to the University as influencing in a remarkable degree the higher education of the west of Scotland. The University of Glasgow is attended by about 2,300 students. The majority of these, about 1,300, are students in the arts subjects—Latin, Greek, mathematics, logic, moral philosophy, English, and natural philosophy or dynamics and physics. These students attend college for six months in the year. On an average they attend three courses of lectures, involving from three to four hours a day in the lecture-room, and implying a large amount of home work in exercises and preparation for oral examination, which is part of the teaching. If they take a complete course of arts, they spend three, four, or five winter sessions in these classes. But many attend for a year or two only, taking such classes of the course as suit them. Side by side with these arts classes are classes in engineering and astronomy, in zoology and geology, in botany and in chemistry. The four latter subjects appear to be mainly taught in connection with the curriculum for medical students. The average fee per student per class is 3*l.* 3*s.* per session, so that his average attendance in three classes costs a student altogether about 10*l.* 10*s.* a session. Glasgow University. Fees.

There are two striking things in connection with this university system. The number of students is enormous, and access to the courses is cheap and untrammelled, every student going to such classes as he wants. Influence of its teaching.

The students find lodgings suitable to their means in the city, and many of them, we are told, manage to [illegible]h their winter session and pay for their education

The most important section of the University, with reference to technical instruction, is the physical department under Prof. Sir William Thomson. About 220 students pass through his classes, the more advanced of whom work in the physical laboratory. These have the great advantage of becoming familiar with the methods of investigation employed in his important researches, and of using the refined apparatus and instruments constructed by him. It is unnecessary to point out the inestimable value to technical students of intimate intercourse with such a Master.

Chemistry, Glasgow University.

The chemical laboratory contained in a building in which utility has, we fear, been subordinated to architectural design, is under the charge of Professor Fergusson. It contains a considerable number of students.

Visits to Glasgow manufactories.

We visited several representative establishments in and near Glasgow, in the mechanical engineering, textile, chemical, and shipbuilding industries, and ascertained from the managers and leading manufacturers the extent to which the existing facilities for scientific instruction are utilised by their foremen and workpeople. Some interesting tables were handed to us showing the number of chemists, foremen, and others in the employ of Messrs. Charles Tennant & Co., who have attended one or other of the various institutions we have mentioned. They will be found in the Appendix.

At a large worsted factory at Greenock there is a school in connection with the works in which the "hands" are trained from childhood, and the proprietors are satisfied that this training under their own care is amply repaid by the increased intelligence and aptitude of the scholars.

Women tracers.

We had an opportunity of seeing a large engineering establishment in which young women are employed as tracers. They are very expert at this work, and earn from 14*s.* to 15*s.* per week. Many of the apprentices and young men employed by this firm attend evening schools, and the employers do all in their power, short of compulsion, to encourage such attendance.

Absence of apprentices in Clyde shipbuilding yard.

In one of the most extensive of the Clyde ship-building yards, in which 500 youths under 21 are employed, there is no actual apprenticeship. Few of them have any theoretical instruction other than they obtain at the night classes. In the drawing office, of the 25 draughtsmen employed, 3 were Germans. In another ship-building yard many of the youths attended the Andersonian Institute, the College of Science, and the School of Art.

In the principal chemical works none of the workmen except those engaged in the laboratory had a practical acquaintance with chemistry.

Young men and apprentices attend evening classes.

The conversations with employers in Glasgow impressed upon us the belief that a very large proportion of the more intelligent young men employed in industrial pursuits have attended, and

are now present at, the various colleges and evening classes in the town. The excellence and value of the instruction thus obtained was freely acknowledged, and we learned that many young men travel considerable distances from outlying suburbs to be present at these classes. So far as our enquiries have enabled us to ascertain the fact, the young men of the Glasgow district employed in the various works, avail themselves more generally than those of other cities similarly circumstanced, of evening instruction in science and in mechanical drawing.

XXIX.—EDINBURGH.

Edinburgh.

Our visit to Edinburgh was a hurried one, and we must confine our remarks in regard to this important city to those establishments and departments having a direct bearing on our inquiry. In the University we visited, the department of mechanical engineering under Prof. Fleeming Jenkin, F.R.S.; also the department of physics, under Prof. Tait, F.R.S., by whom the principles of the science are taught without direct technical application. A certain number of students assist him in the important work of carrying on original investigation in his private laboratory. The new chemical laboratory under the direction of Prof. Crum Brown, F.R.S., in connection with the new medical buildings, is most complete.

University.

Watt Institute and School of Art.

The Watt Institute and School of Art.—This was founded in 1821 by Mr. Leonard Horner. The present building was opened in 1873, and cost 12,000*l.* This is one of the most important evening schools in the United Kingdom, and has probably been as successful in its work as any similar institution in Scotland. It is admirably conducted, the leading men in Edinburgh taking great interest in it. In its constitution and sphere of activity it resembles the Midland Institute at Birmingham, and the College of Science and Art in Glasgow. The total number of students in 1882 was 2,871, and the annual receipts from students' fees and subscriptions were 1,302*l.* The institution requires, however, further funds for duly carrying out its object; especially for suitable laboratories and for the apparatus requisite for teaching physics, mechanics, &c.; expectations are held out that assistance will be given from Heriot's Hospital Funds. At the opening of the session in 1882, Lord Shand delivered an important address on technical education, and on the future work of the school.

Number of students.

Science and Art Museum, Edinburgh.

The Science and Art Museum.—This museum, originally established in 1812, as the Natural History Museum of Edinburgh, was transferred to the Science and Art Department

Edinburgh Science and Art Museum.

in 1854, and reconstructed from the designs of Capt. Fowke, R.E. It was reorganised in 1873, the management of the Natural History Collections being severed from that of the Industrial Museum. The industrial section has been under the management of Prof. Archer since 1860. After the exhibition of 1851, the authorities acquired a large collection of raw and manufactured articles, together with models presented by the Highland Society, which formed the nucleus of the museum. The collections are being continually increased, and under the energetic management of Prof. Archer a very complete and instructive series of illustrations of the different stages in the manufacture of metal work, pottery, glass, and of numerous other industrial productions, has been added to the museum. Many excellent models of machinery and apparatus used in the various industries have been prepared under the direction of Prof. Archer, by workmen employed on the premises. The object aimed at is to give to this museum a special technological character. There is a good library for the use of students, and a complete collection of the specifications of patents. In addition to the technological specimens, there is a good general museum of science and art.

Testimony that the technological collections are of public utility.

The Commissioners, who were received by Prof. Archer, inspected the various departments of the museum, and sought special information respecting the extent to which manufacturers and others interested in the various processes so excellently displayed in the galleries, availed themselves of the museum for the purpose of study. Prof. Archer assured them that he had received abundant testimony both from manufacturers and workpeople that the facilities here afforded had been of service to them, and in support of his statement, he has forwarded to the Commissioners some letters bearing upon this question, which will be found in the Appendix, Vol. III.

XXX.—IRELAND.

Ireland. Circular of inquiry.

The importance of the inquiry, in relation to the special condition and needs of Ireland, was too obvious to be overlooked. A preliminary circular of questions, very widely distributed, elicited much useful information, of which the Commissioners publish a selection, with tabulated abstract, which will be found in the Appendix, Vol. IV.; but considering it expedient to make personal investigation in the country itself, we held public inquiry in Dublin, Belfast, and Cork, and visited some other places in the South and West of Ireland. Great pains have been taken to obtain the views of representative persons who have given serious attention to the subject. The opinions thus expressed, while necessarily coloured by individual predilections,

and divergent in many particulars, are not wholly irreconcilable, and they contribute materially to a sound judgment on the matter. Ireland.

There will be found in the evidence of these witnesses, a general agreement in regard to the almost exclusive dependence of the population upon agriculture, and to the want of skill with which it is carried on. Manufactures, for which certain districts were at one time famous, have disappeared; some, like the hand-loom weaving, superseded by the processes of steam power; others, like the furniture and cabinet making, for which Dublin was once famous, having declined from causes not so apparent. On the other hand, the tweed manufactures of County Cork and the linen and other industries of the North are proofs, if such were wanted, that enterprise, confidence, and capital will find in the people ingenuity and industry not unlike that shown by those of the manufacturing districts of Great Britain, where, indeed, Irish labour is so extensively employed. The deficiency in native coal would have to be overcome, in the same way as has been done in Switzerland and in other countries even worse off in that respect than Ireland is. There is generally abundant turf for fuel, and in many parts of the country water power abounds, of which little or no use is made. The minerals are said to be incapable of being worked with profit, but some interesting information has been tendered with regard to the capabilities of the marbles of Galway and other parts, of which varied and beautiful examples are exhibited in the Museum of the Royal College of Science. Valuable granite and limestone also are worked with a certain degree of energy; probably with better means of conveyance, such as may be anticipated under the provisions of the Tramways Act, 1883, these and other natural products may be more profitably utilized. Wood, straw, and flax are among the materials relied upon for local industries. In Killarney and some other districts there are produced bracelets and other like ornaments carved in bog oak, and cabinets, tables, &c., in which oak, arbutus, and other native woods are inlaid. Much traditional ingenuity is displayed in the execution of this work. But there is a lamentable poverty of design which is in remarkable contrast to the excellence attained with like materials in the Black Forest and in the Tyrol, where the village workers have had the advantage of being educated in the special schools described in another part of the Report. At Belleek a pottery has been established, and its productions have attained a considerable reputation; but the enterprise has not been a commercial success, and it is said to have been impeded by the difficulty of retaining the youth of the locality, with whom the allurements of emigration have outbalanced the advantages of comparatively good wages in the factory.

Character of the evidence.

Manufactures.

Deficiency in coal.

Minerals.

Wood, straw, and flax.

Poverty of design.

Belleek pottery.

Many parts of the country are well adapted for growing osiers, which it is thought might be extensively and profitably employed

Osiers and basket making.

Ireland.

in basket making; and, while it is said that one public company alone, in London, consumes weekly 300 tons of the peat moss litter, which is so extensively imported from the continent, it does not appear that any serious quantity of such product is obtained, as it might be, from the enormous area ot bog land in Ireland. Wool and hides are generally bought up by travelling merchants, chiefly for exportation. There were, however, at the Cork Industrial Exhibition, many most encouraging signs of native enterprise. The Commissioners are much indebted to Dr. Sullivan for the scheme which he has furnished in relation to industrial education which will be found in the Appendix, Vol. III.

Wool and hides exported.

Belfast, the flax manufacture not flourishing.

The staple trade of Belfast and the adjacent district, in the manufacture of flax, is by no means in a flourishing condition, and though this fact may, to some extent, be attributable to the substitution of cotton, woollen, and other fibres, in fabrics formerly made of flax, and, in some degree also, to the extension of the foreign flax manufactures, it is probable that much can be done locally to remedy existing defects and to place the trade on a more advantageous basis.

Evidence respecting the value of technical training for Belfast.

From the evidence taken in Belfast, it will be seen that in the training of workmen, foremen, and even masters, a much larger degree of technical instruction in the arts and sciences relating to the trade might well be applied, and the advantages enjoyed by their Continental rivals, in the possession of such educational facilities, are now generally acknowledged. To meet this want, a project for establishing a technical school in connection with the Belfast linen trade has recently been set on foot, the object of which will mainly be to give instruction in matters that relate to the weaving, bleaching, dyeing, and printing of linen goods. It is generally admitted that in certain of these processes the Belfast industry is not so advanced as that of France or Belgium. Even in the higher class of damasks, the Irish production is hardly holding its own, while in fancy and coloured goods, where a knowledge of design and of the chemistry of dyeing come most into play, the superior attractiveness of many Continental productions is placing the Belfast makers at a serious disadvantage, especially in large markets like America, where the Irish goods once enjoyed almost a monopoly.

Superior position of France and Belgium.

More attention devoted to technical instruction on the Continent.

There can be little doubt that both the workmen and masters on the Continent have paid more attention to these matters than has been given to them by the Irish manufacturers, and that, to meet the requirements of the day, it will be absolutely necessary to devote more attention to perfection of design and colouring, which enter now so largely into this trade.

Facilities for instruction in science and art in Belfast.

With the exception of some successful classes in chemistry and mathematics held at the Working Men's Institute, there seems but little provision in Belfast for the teaching of those arts and sciences which are at the present time so important in their

application to the trade of the town. It is probable that the proposed technical school, in association with the existing School of Art, will tend in a great measure to supply this want. Ireland.

In addition to certain changes (which we recommend in our conclusions) in the books and the ordinary curriculum of the primary schools in the direction of artizan training, the establishment of a larger number of evening classes in science and technical subjects is highly desirable. The Queen's College of Belfast, whilst enjoying the services of eminent science professors, is at present doing but little in the way of higher scientific instruction as applied to industry; indeed, the accommodation for this branch of study is, at the present time, wholly inadquate, and may with great advantage be increased; enabling classes in chemistry and physics, especially in the evening to be provided. Queen's College.

A larger measure of scientific attention might also with advantage be bestowed on the cultivation of flax in Ireland, both in the interest of the agriculturist and the manufacturer. As compared with the cultivation of that fibre in Belgium and France, the Irish industry is far behind. Insufficient attention to the processes of cultivation, and want of knowledge and skill in the manipulation of the fibre, tell with most injurious effect on the manufacturing value of the commodity. If adequate pains were taken by the farmer, and if a full measure of scientific teaching were brought to bear on the now somewhat antiquated methods of preparation, a substantial advantage would be gained not only by the agriculturist, but also by the Irish manufacturer, who now depends far too much for his supplies of the raw material on foreign countries, which in many cases, from soils inferior to that of Ireland, contrive to produce an excellent fibre. The population engaged in the manufacturing industries in the Belfast district, leave little to be desired as to their intelligence and general aptitude. Cultivation of flax requires more skilled attention.

Although we have refrained in our report from speaking of the industrial establishments which we have visited, this reticence seems unnecessary in regard to the interesting and importan works (as being unique in Ireland) of Messrs. Marcus Ward, in whose handsome and commodious premises the processes of engraving, lithography, and colour printing, are conducted on a vast scale and in an endless variety of examples. Besides the ordinary applications of these processes to the manufacture of tickets, labels, note paper, and other commercial articles, the designing and printing of the well-known Christmas cards, almanacks, and other work of a more or less artistic character, form prominent features in this remarkable establishment. Works of Messrs. M. Ward, Belfast.

The designs used in this business are chiefly produced by the staff of designers employed on the premises, and they have to be specially adapted for the particular processes of the firm. In their training, the instruction of the Art School has played a useful part; many of the persons engaged in the artistic department having been well grounded in that school. Firm employ their own designers.

Instruction in the Belfast School of Art not applicable to training of linen designers.

To a limited extent the instruction given in the Art School has also been of service to the staple linen industry, but its influence cannot be great until the student has been taught in the factory, or in a special school, to apply his knowledge of art to the requirements of the fabric with which he has to deal. It is intended to associate the existing Art School with the proposed technical school in such a way as to make the art teaching subserve in the largest possible way the industrial requirements of the town.

Shipbuilding and engineering trades in Belfast.

The shipbuilding and engineering industry of Belfast has of late years experienced an enormous development, and probably 8,000 hands are directly engaged in it. This trade seems to be conducted with great success, and the work produced is of the best order. With the exception of a few certificates gained at the science classes of the Working Men's Institute, but little artizan teaching is brought to bear on the shipbuilding and marine engineering establishments, nor is it thought likely by the employers that any direct trade instruction can be usefully applied. There is, however, a prevalent opinion in the trade, in favour of increased facilities for the instruction of young artizans in mechanics, elementary mathematics, and in mechanical drawing, which it is thought would be of great value both in the general culture and economical value of the men.

Domestic industries.

It will be observed that in very many parts of the country there is an active and hopeful spirit in favour of establishing domestic industries, and it is expedient that local committees, such as are suggested by several of the witnesses, should be formed to originate and guide efforts to that desirable end. Such committees would possess the requisite knowledge with regard to the materials available in their particular neighbourhoods, and as to the aptitude of the people, and they should be alive to the conditions determining the probability of commercial success. To them, obviously, it must be left to advise what kind of industry it may be most expedient to give direct encouragement to. The methods of instruction may be varied, and the system under which it is encouraged should be elastic. In the primary schools under the National Board, in such District schools as may be established, as well as in night classes, the teaching may be more or less specialised, and should be judiciously encouraged by result payments, as well as by aiding in the training and payment of resident and itinerant teachers.

Industries which might be introduced in Ireland.

Knitting and crochet work, basket-making, wood-carving, straw-plaiting, and the making of straw-envelopes for bottles, are among the industries most generally advocated. Lace-making has a remarkable hold, and should be greatly improved in design and quality by the circulation of the more perfect examples which have been sent over from South Kensington.

Fishing nets.

It appears that the nets used in the Irish fisheries are almost all imported. Some thirty years ago, earnest efforts were made

to establish this industry, by training the young women of the Galway coast in net making, and in spinning the hemp and flax into twine for the purpose, but there remains no trace of the manufacture, which seems to have disappeared, like so many of a similar character, with the decline of the country and the emigration of the people for whom it had provided partial employment. Much encouraging testimony is borne in the evidence with regard to the practicability of a large and lucrative trade in the development of fish curing, and especially in the pickling of pilchards, as also in the preparation of salts and other products obtainable from kelp. Ireland. Fish curing.

But after making the fullest allowance for the capabilities of the country in all other directions, agriculture must remain infinitely the most important interest, and it will be observed that the Commissioners have devoted to it the attention which in their judgment the subject deserved. Agriculture.

In their First Report, the Commissioners have stated their opinion that efficient elementary education is the essential foundation for subsequent technical training. They have consequently made it their business to inquire somewhat into the provision for primary schooling under the National Board of Education. According to the Report presented to Parliament last year, it appears that 7,705 National Schools were then in operation, of which about one-fourth were vested in Trustees, or in the Board itself. Accommodation was provided for 670,178, and the average daily attendance is given as 469,192. The majority of the schools are "mixed," attended by children in the proportion of 78·9 Roman Catholics and 21·1 Protestants. It appears, however, that the per-centage of schools exhibiting a mixed attendance has steadily diminished from 58·6 in 1874 to 54·0 in 1882. Among the schools attended exclusively by Roman Catholics are more than 200 attached to convents, in which the rules of the Board are carried out, under the direction of the members of the various religious orders, and where special teaching is often given in useful handicrafts. Some of these convent schools visited by the Commissioners, in the excellence of their buildings, fittings, and appliances, left nothing to be desired. The Sisters take an active part in the conduct of the schools, and their aid is an important element, but they are not reckoned in calculating the staff of teachers. The rules which regulate the exhibition of religious emblems are observed in these as in all other National Schools. Condition of primary education. Roman Catholic schools. Excellence of convent schools.

It appears from the Census of 1881 that the per-centage of illiterates in Ireland has diminished in 40 years from 52·7 to 25·2. A system of payment on the results of individual examinations has been in operation for 11 years, and the effect has admittedly been to have improved in a very gratifying manner the average attendance, and the per-centage of children in the higher classes. Under it also the teachers' emoluments—four- Per-centage of illiterates.

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fifths of which in Ireland come from the Parliamentary vote—have been more than doubled.

Number of untrained teachers in Ireland.

With regard to the teachers employed, it has been a matter of general regret that less than one-third have been efficiently trained; the untrained teachers, however, had generally served as monitors in the ordinary and Model schools. A confident hope is entertained that under the Minute of last year, by which aid will be given towards the cost of training in denominational colleges, this serious defect will be gradually corrected.

Needlework, drawing, agriculture.

It appears that 136,065 pupils were examined in needlework, of whom 94·6 per cent. passed; 23,210 in drawing, of whom 73·3 per cent. passed, and 44,493 in agriculture, of whom 47·5 per cent. passed. The system under which the latter subject is taught will be found detailed in the report of our Sub-Commissioner, Mr. H. M. Jenkins, and in the evidence given before the Commissioners on the occasion of their visits to Glasnevin and Cork.

Instruction of teachers in agriculture.

We were favourably impressed with the arrangements for the instruction of the teachers, and with the testimony to the value of the farms and gardens attached to the rural schools, for purposes of practical instruction; the desirability of increasing their number, in view of the altered conditions under which the land is now cultivated, is indubitable, and the hopeful spirit by which the small farmers are said to be animated may, we think, be deemed a satisfactory sign for the future.

Early attention to importance of industrial education.

As far back as 1837, the importance of providing for industrial, equally with agricultural, education, was recognised by the National Board, and the following passages extracted from the Fourth Annual Report presented to Parliament will be read with interest, as demonstrating that it is no novel want to which expression is now so widely given, and indicating a method which is now in process of being adopted:—

> "We intend" (say the National Board) "that our normal establishment, which we hope will be completed in January next, shall consist of two departments, one for elementary, the other for scientific instruction, and that the latter shall teach, in particular, those branches of science which have a practical application to husbandry and handicraft. We also purpose having a school for industry in the immediate neighbourhood of Dublin, with workrooms, and a farm of from 40 to 50 acres annexed to it, and that those who attend it shall be practised at stated times in different descriptions of manual work, and in the general business of agriculture.
>
> "Our object is not to teach trades, but to facilitate a perfect learning of them by explaining the principles upon which they depend, and habituating young persons to expertness in the use of their hands."

Training was to be obligatory on teachers.

It was further intimated, in the same Report, that the instruction thus to be provided was to be obligatory on all teachers trained in the Normal School, and that similar use

was to be made of the Model Schools, where the teaching of manual occupations and agriculture was to be equally practical in character. It will be observed that many of the suggestions offered in evidence at Dublin and elsewhere are flattering to the prescience thus manifested. Ireland.

It will be seen from the figures previously quoted, that very little instruction is given in drawing, and this is equally the case as regards physical science. With reference to the value of the teaching imparted to girls in needlework, the most contradictory opinions will be found expressed in evidence. It is probably true that while the requirement of the National Board "that instruction shall be given in plain needlework in all schools," is loyally observed, the commendable desire for remunerative employment has, especially in convent schools, largely stimulated more ambitious aims which may not have been always satisfactorily realised. Want of instruction in drawing and in physical science. Needlework.

While, as has been stated, many of the religious orders avail themselves of, and adapt their teaching to, the system of the National Board, there are others which prefer to work independently at once of its control and its subventions. Of these the most important is the Order of Christian Brothers, which in Ireland, as in France and Belgium, has distinguished itself by the zeal and skill with which it has carried out the educational mission to which it has devoted itself, and by its resolute resistance to all restraint by either civil or ecclesiastical authority. In Ireland this body is said to have an average of 25,000 children under instruction. Their remarkable day school at Cork was visited by the Commissioners, and testimony to its usefulness is borne by the witnesses examined in that city. Similar schools are to be found in other parts of the island, some, like the one at Limerick, attached to the Industrial School there conducted by the Brotherhood. In the latter schools and in the Reformatories the Order has no difficulty in accepting the Government grants, since they do not involve any restraints upon the freedom of their methods. Schools conducted by religious orders connected with the National Board. Christian Brothers' school at Cork.

It is in these Reformatory and Industrial schools that the most notable examples of well adapted industrial instruction are to be found. Sir John Lentaigne, to whose zealous direction and supervision much of their success is owing, in his last report gives 1,140 as the number of boys and girls in Reformatory, and 6,078 in Industrial schools last year. Of these the Commissioners personally visited the institutions at Artane and Merrion, near Dublin; Sunday's Well and St. Nicholas, Cork City; Upton, Kinsale, and Clonakilty (County Cork); and others at Killarney, Limerick, Galway, Oughterard, Clifden, and Westport. In these schools, boys are instructed in a great variety of trades, being trained as weavers, stocking makers, bakers, carpenters, wheelwrights, saddlers, tailors, blacksmiths, tinsmiths, and in every department of farming and gardening. In some cases, as at Artane, Industrial and Reformatory schools. Artane school.

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a large staff of instructors is employed under the Brothers, and goods are manufactured for sale much as in an ordinary factory.

Galway industrial school.

In others, as at Galway, the Brothers undertake repairs to carts and ploughs, aiming at doing their work in the best possible manner, charging market prices, and getting abundant employment without exciting the animosity of ordinary tradesmen. Boys trained in these institutions leave at 16, on the expiration of their term, much in the position claimed for the pupils of the apprenticeship schools abroad, getting ready employment at their trades at wages varying from 8*s.* to 15*s.* a week.

Girls are taught domestic work and various trades.

The girls receive instruction in every branch of domestic work, washing, cooking, baking, and sewing; dairy work also receives attention, though not on the scientific methods which are followed at Cork. Lace-making and needlework, embroidery of vestments and banners, glove-making, book-binding, and card-painting, are among the trades pursued with fair commercial success, but the most remunerative, as well as the most useful, appears to be plain needlework. In some of these institutions externes are received as day scholars, admission being accepted by the parents as a privilege.

Combination of industrial schools with day schools.

In other cases Industrial schools and day schools under the National Board are combined, and so far from the industrial children being treated as of a lower caste, precautions have to be taken to prevent their manners being deteriorated by contact with the ruder children, who have not the constant domestic supervision of the Sisters. The inmates of nearly one-half of the Industrial schools are sent for literary instruction to the ordinary national schools, conducted on the same premises, and although not paid on the results, are examined and generally pass equally well with the ordinary pupils.

Importance of systematic examination and payment on results.

It is suggested with much force that systematic examination with payment on results, for industrial as well as literary success, would be preferable to the present system under which a like capitation grant is paid to the worst as to the best managed institutions.

Expenditure.

The total expenditure on all heads on these Industrial (omitting the Reformatory) schools, with their 6,078 inmates, is given as 142,388*l.* 13*s.* 2*d.*, including about 20,000*l.* for new buildings. To this sum the Government grant of 5*s.* per week contributes 74,997*l.* 12*s.* 11*d.*, or about one-half the total cost; local rates about one-sixth; the remainder being made up by industrial profits, subscriptions, &c.

Criminal and neglected children enjoy facilities as respects industrial education denied to others.

At this large cost, criminal and neglected children are rescued from ignorance and depravity, and made, in an overwhelming proportion, as abundant proofs testify—creditable members of society. In some rare instances the training of *workhouse* children is comparable to that which is the happy lot of those just described. But, in the main, it may be assumed that the practical perfection of industrial training is assured alone to those who have been rescued by the police and who have become the children of the State. The problem is thus how best to devise means by which other classes of the community can secure like advantages

for their children, and to its solution it will be observed that much of the evidence is addressed. Ireland.

Many of the witnesses deplored the absence of night classes for the instruction of those who are inclined to continue the studies of the day school, or to make good its deficiencies. But it will also be remarked that where such classes are in actual operation, many who thus desired them were ignorant of their existence; as they were also of the inducements offered by the Science and Art Department and by the City and Guilds of London Institute, towards their establishment by local committees in Ireland equally with England and Scotland. Absence of night classes in Ireland.

It has been urged with much force that while it may be possible to give this kind of teaching a more direct bearing upon local wants, it is expedient rather to extend and amplify the existing systems than to disturb them for the purpose of substituting others. There is a general disposition to look to the Government for the initiative, and a conviction that local efforts must be sustained by State subsidies. The small extent to which Boards of Guardians have acted on the powers given them to aid educational efforts, is not encouraging. The Free Libraries Act has only been adopted in Cork, and even in that solitary instance it is only now being brought into anything like complete operation. The poverty of the country is naturally pleaded in explanation, but on the other hand the experience of the Munster Dairy School justifies the conviction that, with the increasingly intelligent appreciation of the need for, and of the value of, these facilities, judicious efforts on the part of the central authority will evoke the essential local co-operation. Direction in which improvement should be attempted.

With regard to the provision for secondary and higher education, it will suffice here to say that while regret is expressed that under the system of the Intermediate Board due encouragement is not given to the teaching of practical science, very gratifying testimony is borne to the improvement in other respects, effected under its operation, in the colleges and grammar schools of Ireland, especially in the matter of better appliances. The work of the Royal College of Science at Dublin, with its Museum and Department of Manufactures, will be found fully described in evidence, and certain reforms are recommended which we believe will, if adopted, have the effect of largely increasing their usefulness. The Commissioners inspected with much interest the Queen's Colleges at Belfast and Cork, and are strongly impressed with the importance of sustaining these institutions and the kindred college at Galway, which are rendering excellent service by providing the means of higher scientific training. We think it right to mention the munificence of Mr. W. H. Crawford to the Cork College. He has contributed 2,000 volumes of books to the library, has built and furnished the Astronomical Observatory, has paid over half the cost of the Botanical Houses, and almost the entire expense of filling them with their excellent collection of Secondary and higher education. Donation by Mr. Crawford to Queen's College, Cork.

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tropical and other plants, has added about seven acres to the College grounds, and proposes to build on this site, additional dwellings for the Professors, and a hall of residence for the students, at a cost of over 20,000*l.*

Royal University.

It is early to speak of the work of the Royal University, which only presented its First Report to Parliament last year, but the Commissioners sympathise with the feeling, very widely expressed, that these varied and graduated organisations are capable of being expanded and adapted to the wants of the country, and while they are worthy of the generous support of Parliament, it is hoped that their funds will be augmented from other sources, so that they may be enabled to give to Ireland the full educational advantages for which its people display such honourable avidity.

PART IV.—CONCLUSIONS.

Progress of manufactures abroad.

It will have been seen from the preceding pages of this Report that we have attached considerable relative importance to that portion of our commission which directed us to inquire into the condition of industry in foreign countries; and it is our duty to state that, although the display of Continental manufactures at the Paris International Exhibition in 1878 had led us to expect great progress, we were not prepared for so remarkable a development of their natural resources, nor for such perfection in their industrial establishments, as we actually found in France, in Germany, in Belgium, and in Switzerland. Much machinery of all kinds is now produced abroad equal in finish and in efficiency to that of this country, and we found it in numerous instances applied to manufactures with as great skill and intelligence as with us.

New chemical processes.

In some branches of industry, more especially in those requiring an intimate acquaintance with organic chemistry, as, for instance, in the preparation of artificial colours from coal tar, Germany has unquestionably taken the lead.

The introduction by Solvay, of Brussels, of the ammonia process for the manufacture of soda, and the German application of strontia in sugar refining, constitute new departures in those arts. In the economical production of coke we are now only slowly following in the footsteps of our Continental neighbours, whilst the experiments which have been carried on for nearly a quarter of a century in France for recovering the tar and ammonia in this process have only quite recently engaged our attention.

Ventilation of mines, and sinking of shafts.

The ventilation of deep mines by means of exhausting fans was brought to perfection in Belgium earlier than with us, and, although our methods of sinking shafts served for many years as models for other countries, improvements thereon were made abroad which we are now adopting with advantage.

Turbines.

The abundant water power in Switzerland and in other mountainous districts is utilized for motive purposes by means of turbines, perfect in design and execution.

Dynamo-machines.

The construction of the dynamo-machine by Gramme gave the first impulse to the general use of electricity for lighting, and to the various new applications of that force which appear likely to exercise so great an influence upon the industry of the world; and in all these applications, at least as much activity is exhibited on the Continent as with us.

Roofs and bridges.

In the construction of roofs and bridges, more especially in Germany, accurate mathematical knowledge has been usefully applied to the attainment of the necess[illegible]ith the least consumption of materials.

Calico-printing. Certain printed cottons of the highest class, produced at Mulhouse from Parisian designs, are not excelled, and rarely equalled, in this or in any other country, although the distance between our general productions in this department and those of Alsace is no longer so great as it was ten or twenty years ago. The soft all-wool fabrics of Rheims and Roubaix are scarcely equalled as yet on the average by those of Bradford, especially as respects the dyeing.

Woollen fabrics.

Silk. Silk dyeing and finishing is still as much the speciality of Lyons as is the production of the beautiful silk fabrics on its hand-looms, for which it has so long been pre-eminent.

Woollen yarns. The export from Verviers to Scotland of woollen yarns, carded and spun by machinery made in England, from South American wool formerly purchased in Liverpool and London, but for which Antwerp is now becoming the chief market, is an instance of an intelligent, careful, and persevering attention to details having established a special trade, which the cheaper labour of the Belgian factories now assists in preserving.

New textile industries. The ribbon trade of Basle, that in velvets and silks of every kind at Crefeld, and in mixed fabrics at Chemnitz, are examples of recently established or transformed industries which have rarely been excelled in boldness of enterprise and in success by anything of the same kind accomplished in our own country. And it may not be improper to mention here that, in whatever degree the technical instruction of our Continental rivals may have trained them for competition with ourselves, in their own, in neutral, and to some extent in our home markets, much of their success is due to more painstaking, more pliancy, and greater thrift; and also to the general cultivation, the knowledge of modern languages, and of economic geography usually possessed by Continental manufacturers.

Greater thrift, &c. of Continental manufacturer.

Our own position in construction and manufactures. But, great as has been the progress of foreign countries, and keen as is their rivalry with us in many important branches, we have no hesitation in stating our conviction, which we believe to be shared by Continental manufacturers themselves, that, taking the state of the arts of construction and the staple manufactures as a whole, our people still maintain their position at the head of the industrial world. Not only has nearly every important machine and process employed in manufactures been either invented or perfected in this country in the past, but it is not too much to say that most of the prominent new industrial departures of modern times are due to the inventive power and practical skill of our countrymen. Amongst these are the great invention of Bessemer for the production of steel in enormous quantities, by which alone, or with its modification by Thomas and Gilchrist, enabling the commonest description of iron to be used for the purpose, steel is now obtained at one-tenth of the price of twenty years ago; the Weldon, Hargreaves and Deacon processes, which have revolutionized the alkali trade; the manufacture of aniline colours by Perkin; the new processes in the production of silk fabrics by Lister; the numerous applications of water pressure to industrial purposes by Armstrong; the Nasmyth steam hammer; the compound steam

New departures at home.

engine, as a source of great economy of fuel; and the practical application of electricity to land and submarine telegraphy by Cooke, Wheatstone, Thomson, and others.

Machinery made in this country is more extensively exported than at any former period; the best machines constructed abroad are, in the main, and with the exceptions which we have named, made, with slight, if any, modifications, after English models. A large proportion of the power looms exhibited and used in the Continental weaving-schools has been imported from this country. In the manufacture of iron and steel we stand pre-eminent, and we are practically the naval architects of the world. Our technical journals, such as those of the Institutes of Civil and Mechanical Engineers, and of the Iron and Steel Institute, are industriously searched and their contents assimilated abroad.

Adoption of English models.

Power looms.

Iron and steel.

Ships.

Technical journals.

In those textile manufactures in which other nations have hitherto excelled us, as in soft all-wool goods, we are gaining ground. We saw at Bradford, merinos manufactured and finished in this country, which would bear comparison in texture and in colour with the best of those of the French looms and dye-houses, and in the delicate fabrics of Nottingham and Macclesfield (thanks, in great measure, to their local Schools of Art) we no longer rely on France for designs.

Improvements in English textiles.

In art manufactures proper, notably in porcelain, earthenware, and glass, as also in decorative furniture, our productions are of conspicuous excellence. It is possible that this may be due in a certain degree to the employment, in some branches, of skilled workers trained in foreign countries, and we cannot do otherwise than acknowledge the pre-eminence in the main of our French neighbours, in design as applied to decorative work, or disregard the efforts which they are making to maintain that pre-eminence, and those made in Belgium and Italy to emulate them.

Art manufactures.

French and Belgian decorative work.

The beginnings of the modern industrial system are due in the main, as we have indicated, to Great Britain. Before factories founded on the inventions of Watt, of Arkwright, and Crompton, had time to take root abroad, and whilst our own commerce and manufactures increased from year to year, the great wars of the early part of this century absorbed the energies and dissipated the capital of Continental Europe. For many years after the peace we retained almost exclusive possession of the improved machinery employed in the cotton, woollen, and linen manufactures. By various acts of the last century, which were not repealed till 1825, it was made penal to enlist English artisans for employment abroad; the export of spinning machinery to foreign countries was prohibited until the early years of Your Majesty's reign. Thus, when less than half a century ago, Continental countries began to construct railways and to erect modern mills and mechanical workshops, they found themselves face to face with a full-grown industrial organization in this country, which was almost a sealed book to those who could not obtain access to our factories.

Origin of modern industrial system.

To meet this state of things, foreign countries established technical schools like the École Centrale of Paris, and the Poly-

Origin of technical schools.

technic Schools of Germany and Switzerland, and sent engineers and men of science to England to prepare themselves for becoming teachers of technology in those schools.

Technical education of masters and managers abroad.

Technical High Schools now exist in nearly every Continental State, and are the recognised channel for the instruction of those who are intended to become the technical directors of industrial establishments. Many of the technical chemists have, however, been, and are being, trained in the German Universities. Your Commissioners believe that the success which has attended the foundation of extensive manufacturing establishments, engineering shops, and other works, on the Continent, could not have been achieved to its full extent in the face of many retarding influences, had it not been for the system of high technical instruction in these schools, for the facilities for carrying on original scientific investigation, and for the general appreciation of the value of that instruction, and of original research, which is felt in those countries.

Polytechnic schools.

With the exception of the École Centrale of Paris, all these schools have been created, and are maintained almost entirely, at the expense of the several States; the fees of the students being so low as to constitute only a very small proportion of the total income. The buildings are palatial, the laboratories and museums are costly and extensive, and the staff of professors, who are well paid according to the Continental standard, is so numerous as to admit of the utmost subdivision of the subjects taught. In Germany, as we have stated in a previous part of our Report, the attendance at some of the Polytechnic Schools has lately fallen off, chiefly because the supply of technically trained persons is in excess of the present demand; certainly not because it is held that the training of the School can be dispensed with. The numerous young Germans and Swiss who are glad to find employment in our own manufactories, have almost, without exception, been educated in one or other of the Continental Polytechnic Schools.

Technical knowledge of foreign manufacturers.

Your Commissioners cannot repeat too often that they have been impressed with the general intelligence and technical knowledge of the masters and managers of industrial establishments on the Continent. They have found that these persons, as a rule, possess a sound knowledge of the sciences upon which their industry depends. They are familiar with every new scientific discovery of importance, and appreciate its applicability to their special industry. They adopt not only the inventions and improvements made in their own country, but also those of the world at large, thanks to their knowledge of foreign languages and of the conditions of manufacture prevalent elsewhere.

Technical schools for foremen abroad.

The creation abroad of technical schools for boys intending to become foremen, is of much more recent date than that of the Polytechnic Schools. To this statement the foundation during the First Empire of the three French Écoles des Arts et Métiers, at Châlons, Aix, and Angers, is only an apparent exception, because they simply vegetated until their reorganization within the last twenty-five or thirty years. Mining schools were, however

established in Prussia in the last century, and in France about 1817. Among the examples of schools for foremen are those of Winterthur in Switzerland, Chemnitz in Saxony, and Komotau in the Austrian dominions, principally for engineers, and the École des Mines at St. Étienne, the latter more especially for mining and metallurgy. The theoretical instruction in these schools is similar in character, but inferior in degree, to that of the great Polytechnic Schools. On the other hand, considerable attention is devoted in these schools to practical instruction in laboratories and workshops, which is not the case in the Polytechnic Schools. In Prussia, as will be seen from the Ministerial report found in the Appendix, a beginning has been made in the establishment of such secondary technical schools, but, in the words of the report, "its execution will be tedious and costly." In Bavaria the Industrie Schulen, which are technical schools of a grade inferior to the Polytechnic School, give both theoretical and practical instruction, the latter in some cases highly specialized, in preparation either for direct entrance on an industrial career or for further study in the Polytechnic School. In France technical schools of a somewhat lower type are being established all over the country. The one at Rheims, described at p. 75, is an excellent example of these schools. The boys from the Rheims school either enter the École des Arts et Métiers at Châlons, or go into manufactories or into business; in each case with a fair knowledge of theory and manipulation as mechanics or as chemists.

Prussian schools.

French schools.

It is important to bear in mind that the French schools of the type of that at Rheims, though virtually advanced schools, now rank as superior elementary schools, to which the pupils are consequently entitled to claim admission without the payment of any fees.

Intermediate French schools gratuitous.

Up to the present time, however, although a few foremen have received some theoretical instruction in schools of this kind, foreign foremen have not generally been technically instructed, but, as in England, are men who, by dint of steadiness, intelligence, and aptitude for command and organization, have raised themselves from the position of ordinary workmen.

The Continental weaving schools may on the whole, so far as their influence on trade is concerned, be ranked in the first and second categories, that is to say, they are attended by those who propose to become merchants, manufacturers, managers, or foremen. They are held in the highest estimation by some of the most intelligent and successful Continental manufacturers; of this there can be no better proof than the erection, in substitution for the one already existing, of the splendid new weaving schools at Crefeld, probably the most flourishing centre of the general silk trade, at the joint expense of the State, the locality, and the commercial body. Weaving schools for workmen, like the evening and Sunday school of Chemnitz, which must not be confounded with the superior weaving school of that town, are poorly attended, and can have had no sensible influence on the progress of textile manufactures. But there are in many places lectures on weaving and pattern designing largely attended by workmen.

Weaving schools.

Schools for miners and workers in iron and steel abroad.

The French and German schools for miners, and the one which has been quite recently founded in Westphalia for workers in iron and steel, differ from the preceding schools for foremen, inasmuch as they are reserved for the theoretical instruction of men who, having already worked practically at their trades, have distinguished themselves by superior intelligence and good conduct. Most of the German schools of this kind are founded or maintained by the manufacturers, and will, we feel confident, repay the trades, which have had the foresight and public spirit to create them, by training young men to become foremen and leading hands, willing and able to carry out with intelligence the instructions of their superior officers.

Technical instruction for workmen.

Trade and other societies as teaching bodies.

For the technical education of workmen, outside of the workshop, the resources of Continental countries have hitherto been, and are still, very much more limited than has been supposed in this country to be the case. In several of the more important industrial centres of the Continent there exist societies, such as the Sociétés industrielles of Mulhouse, Rheims, Amiens, &c., the Société d'enseignement professionnel du Rhone, which has its headquarters at Lyons, and the Niederoesterreichischer Gewerbe-Verein of Austria; one of the chief objects of which is the development of technical education among workmen and other persons engaged in industry, by means of lectures and by the establishment of schools and museums of technology. These associations are supported mainly by the merchants and manufacturers of the district, to which their operations are restricted. In many cases they are founded and supported, or are greatly assisted, by Chambers of Commerce; these bodies abroad being incorporated and having in France considerable taxing powers over their members, are generally wealthier and more influential than those in our own country. In addition to these sources of income, the associations receive help from the municipality, and sometimes from the State. In Mulhouse, besides promoting education, the Society sees to the material well-being of the workmen by erecting, on a large scale, labourers' dwellings (la cité ouvrière) and by organising savings banks and other economic arrangements; undertaking in this respect, on a smaller scale, what is done in this country by self-sustaining associations like building and co-operative societies of the workpeople themselves. The society in Lyons has established numerous evening classes for elementary and technical instruction, which are attended chiefly by workpeople; and the South Austrian Trade Society, which has its central office in Vienna, has organised several technical day and evening schools for operatives of every grade, which are now under State control, and receive subventions from the Government. But although these Societies, under different names and with varied objects, are very numerous, their sphere of action is limited, and the facilities they offer for evening instruction in science and technology are inferior to those which are at the disposal of our own workmen. No organization like that of the Science and Art Department or of the City and Guilds Institute exists in any Continental country, and the absence of

such organizations has been lamented by many competent persons with whom we came in contact abroad.

In two very important respects, however, the education of a certain proportion of persons employed in industry abroad, is superior to that of English workmen; first, as regards the systematic instruction in drawing given to adult artizans, more especially in France, Belgium, and Italy; and secondly, as to the general diffusion of elementary education in Switzerland and Germany. In some parts of these latter countries, great attention is paid to drawing in the elementary schools. In France, too, (where elementary education has hitherto by no means been so general as in the two former countries), in the case of those workmen who have had the benefit of regular elementary school training, more attention has been paid to elementary drawing than is the case in this country. There are also in all large towns in France, and to a more limited extent in other countries, numerous evening "conférences" and "cours" on almost every subject of interest in art, science and literature, which workmen have the opportunity of attending, as they are entirely gratuitous. Amongst these the most remarkable are the lectures given by eminent men at the Conservatoire des Arts et Métiers of Paris. Most of these are of the nature of lectures rather than of practical instruction. There are, however, in many places excellent and numerously attended Evening and Sunday technical classes, more especially in Belgium and Austria, and there can be no doubt that the instruction thus given, is already exerting a considerable influence on the capacity and intelligence of the workmen, and that this influence will be increasingly felt in the future.

Education of artizans abroad better as respects drawing.

Primary instruction is more generally diffused in Switzerland and Germany.

Lectures and classes on the Continent.

In the evening schools of North Germany (Fortbildungsschulen) the studies of the ordinary elementary school are continued, the further instruction being confined mainly to book-keeping and rudimentary mathematics, with some notions of natural philosophy. In the evening schools of the same class in South Germany, the instruction given is of a more technical character than in the North.

Fortbildungsschulen.

For instruction in drawing, as applied mainly to decorative work in France, and to both constructive and decorative work in Belgium, the opportunities are excellent. The crowded schools of drawing, modelling, carving, and painting, maintained at the expense of the municipalities of Paris, Lyons, Brussels, and other cities—absolutely gratuitous, and open to all comers, well lighted, furnished with the best models, and under the care of teachers full of enthusiasm—stimulate those manufactures and crafts in which the fine arts play a prominent part, to a degree which is without parallel in this country. Instruction in art applied to industry and decoration is now pursued with energy in South Germany and in several of the northern Italian towns, and the influence of this instruction on the employment of the people is becoming very conspicuous in those countries. The Government schools of applied art in France, under the Decree of 1881, of which the Limoges Decorative Arts School is the earliest example, and

Artizan instruction in drawing abroad.

Instruction in applied art.

which, like the above-mentioned schools are gratuitous, should be mentioned in this connection.

Sunday lectures and classes abroad.

The technical lectures and classes to which we have referred are in nearly all Continental States held not only in the evening, but also, and in some branches, as in weaving, principally, on Sundays; and all the great museums and collections are open on Sundays. No one who has seen the crowds of orderly artizans with their families visit the splendid collections of the Louvre and the Conservatoire des Arts et Métiers on a Sunday can have failed to reflect on the powerful educational influence thus brought to bear on that important class of the population.

Home industries.

Home and village industries have been in some cases initiated, in others improved and extended, in districts where, from the poverty of the population and the scarcity of capital, special aids were essential, notably in Baden, Bavaria, and the Tyrol. In the schools established and maintained for this purpose, wood carving, and inlaying, clock-making, filagree work, basket-making, and other simple trades, for which there were local materials and aptitude, have been taught with considerable success. In some cases these industries have been so firmly and permanently established as to render unnecessary the further maintenance of the special schools. In the primary schools of the Black Forest, straw plaiting is taught to girls. Discriminating regard is paid to the capabilities of each sex. In "Women's Work" schools on the Reutlingen model, and in the Professional Schools for girls which have been established in France and the Netherlands, instruction is successfully given, qualifying girls for many useful occupations, though these are scarcely of the kind usually understood under the term of manufactures.

Mr. Mather's report on the United States.

The report of Mr. William Mather to your Commissioners, on his six months' tour throughout the United States of America and Canada, for the purpose of studying the schools and factories of that continent, deserves the most careful perusal. It will be seen that Mr. Mather assigns greater influence on American manufactures to the general education of the American people derived from their common schools, than to their technical schools, the importance of which latter, however, in the training of civil engineers has been experienced for some years, though it has only more recently become recognised by those who are engaged in mechanical engineering and in metallurgical and manufacturing establishments of various kinds. This recognition is, however, now becoming universal. A decided preference is being given in the United States, for the positions of managers and heads of departments, to persons who have received a scientific training in a technical school, and the plan is followed in these schools of combining instruction in "application" with instruction in pure science. Although the conditions of American industry differ in many respects from our own, there can be no doubt that we may derive great advantage from a careful study of what is being done in the way of technical instruction in the United States, as, together with the elementary education of Canada,

it is so graphically described by Mr. Mather. We may add that the accuracy of his statements and conclusions is generally confirmed by the accounts of technical instruction in America which we have received from other competent judges.

Need of technical instruction generally acknowledged at home.

Not many years have passed since the time when it would still have been a matter for argument whether, in order to maintain the high position which this country has attained in the industrial arts, it is incumbent upon us to take care that our managers, our foremen, and our workmen, should, in the degrees compatible with their circumstances, combine theoretical instruction with their acknowledged practical skill. No argument of this kind is needed at the present day. In nearly all the great industrial centres—in the Metropolis, in Glasgow, in Manchester, Liverpool, Oldham, Leeds, Bradford, Huddersfield, Keighley, Sheffield, Nottingham, Birmingham, The Potteries, and elsewhere—more or less flourishing schools of science and art of various grades, together with numerous art and science classes, exist, and their influence may be traced in the productions of the localities in which they are placed. The schools established by Sir W. Armstrong at Elswick; by the London and North-Western Railway Company at Crewe; and those of Messrs. Mather and Platt of Salford, in connection with their engineering works, testify to the importance attached by employers to the theoretical training of young mechanics. The efforts of Messrs. Denny, the eminent shipbuilders of Dumbarton, for encouraging the instruction of their apprentices and for rewarding their workmen for meritorious improvements in details applicable to their work, are proofs of this appreciation. The evidence of Mr. Richardson, of Oldham, and of Mr. Mather, of Salford, is emphatic as to their experience of its economical value.

Special schools established by manufacturers and large employers of labour.

Mechanics' Institutes are being re-organized.

Without more particularly referring to the valuable work in the past, accomplished by the numerous Mechanics' Institutes spread over the country, many of them of long standing, we may point out that they are now largely remodelling their constitutions in order to bring up their teaching to the level of modern requirements, as regards technical instruction. The example of the Manchester Mechanics' Institute may be studied in this connection.

Classes established by leading co-operative societies.

Moreover, as evidencing the desire of the artizans themselves to obtain facilities for instruction both in science and art, we must not omit to mention the classes established and maintained by some of the leading co-operative societies. The Equitable Pioneers' Society of Rochdale has led the way in this, as in so many other social movements. It is much to be wished that the various trades' unions would also consider whether it is not incumbent on them to promote the technical education of their members.

Influence of schools on industries.

The manufacturers of Nottingham speak with no uncertain voice of the important influence of the local school of art on the lace manufacture of that town. Without the Lambeth School, the art productions of Messrs. Doulton [illegible] have come into existence. The linen manufact

are becoming alive to the necessity of technical instruction if competition on equal terms with foreign nations in the more artistic productions, is to be rendered possible. The new generation of engineers and manufacturers of Glasgow has been trained in the technical schools of that city. The City and Guilds of London Institute owes its existence to the conviction of the liverymen that technical instruction is a necessary condition of the welfare of our great industries.

Teaching of natural science.

Natural science is finding its way surely, though slowly, into the curriculum of our older English universities, and of our secondary schools. It is becoming a prominent feature in the upper divisions of the elementary board schools in our large towns. There are scarcely any important metallurgical works in the kingdom without a chemical laboratory in which the raw materials and products are daily subjected to careful analysis by trained chemists. The attainments of the young men who have been trained in the Royal Naval College at Greenwich recommend them for remunerative employment by our great shipbuilding firms.

Desire to ascertain best modes of advancing technical instruction.

In our relations with public bodies and individuals in this country during the progress of our inquiry, the greatest anxiety has been manifested to obtain our advice as to the mode in which technical instruction can be best advanced, and we have to acknowledge the readiness of the Education and Science and Art Departments to receive and act upon suggestions in matters of detail from individual members of the Commission, which it would have been pedantic to delay until the completion of our task. Amongst the suggestions which have thus been made was that of an exhibition of the school-work of all nations, which His Royal Highness the Prince of Wales has consented to add to the Health Exhibition of 1884. This exhibition will be an appropriate illustration of the account of foreign schools contained in the previous parts of this Report. Your Commissioners, during their continental visits, received from the authorities of technical schools numerous assurances of their cordial support and co-operation in such a display.

International Exhibition of school-work in 1884.

Thus, there is no necessity to "preach to the converted," and we may confine ourselves to such considerations as bear upon the improvement and more general diffusion of technical education at home, in accordance with the conditions and needs of our industrial population.

Foreign system of technical instruction not applicable without modification.

In dealing with the question of technical instruction in this country we would, at the outset, state our opinion that it is not desirable that we should introduce the practice of foreign countries into England, without considerable modification. As to the higher education, namely, that for those intended to become proprietors or managers of industrial works, we should not wish that every one of them should continue his theoretical studies till the age of 22 or 23 years in a Polytechnic School, and so lose the advantage of practical instruction in our workshops, (which are really the best technical schools in the world) during the years from 18 or 19 to 21 or 22, when he is best able to profit by it.

We have, also, in the science classes under the Science and Art Department, to the intelligent and able administration of which it is our duty to bear testimony, a system of instruction for the great body of our foremen and workmen, susceptible certainly of improvement, but which, in its main outlines it is not desirable to disturb.

Value of classes under Science and Art Department.

Moreover, in considering by whom the cost of the further development of technical instruction should be borne, we must not forget that, if it be true that in foreign countries almost the entire cost of the highest general and technical instruction is borne by the State, on the other hand, the higher elementary and secondary instruction in science falls on the localities to a much greater extent than with us; whilst, as to the ordinary elementary schools, the cost in Germany and Switzerland is almost exclusively borne by the localities; and this was also the case in France and Belgium until the people of those countries became impatient of the lamentable absence of primary instruction on the part of vast numbers of the rural, and in some instances, of the town population; an evil which large State subventions alone could cure within any reasonable period of time. With the exception of France, there is no European country of the first rank that has an Imperial budget for education comparable in amount with our own. In the United Kingdom at least one-half of the cost of elementary education is defrayed out of Imperial funds, and the instruction of artizans in science and art is almost entirely borne by the State. Hence, it will be necessary to look, in the main, to local resources for any large addition to the funds required for the further development of technical instruction in this country.

Funds for technical instruction, how to be supplied.

In determining what is the best preparation for the industrial career of those who may expect to occupy the highest positions, it is necessary to differentiate between capitalists who will take the general, as distinguished from the technical, direction of large establishments; and those at the head of small undertakings, or the persons more especially charged with the technical details of either. For the education of the former, ample time is available, and they have the choice between several of our modernized grammar schools, to be followed by attendance at the various colleges in which science teaching is made an essential feature, or the great public schools and universities; provided that, in these latter, science and modern languages should take a more prominent place. Either of these methods may furnish an appropriate education for those persons to whom such general cultivation as will prepare them to deal with questions of administration is of greater value than an intimate acquaintance with technical details. It is different in regard to the smaller manufacturers and to the practical managers of works. In their case, sound knowledge of scientific principles has to be combined with the practical training of the factory, and, therefore, the time which can be appropriated to the former, that is, to theoretical instruction, will generally be more limited.

Technical instruction for proprietors and managers.

How this combination is to be carried out will vary with t' trade and with the circumstances of the individual. In those c

in which theoretical knowledge and scientific training are of pre-eminent importance, as in the case of the manufacturer of fine chemicals, or in that of the metallurgical chemist, or the electrical engineer, the higher technical education may with advantage be extended to the age of 21 or 22. In the cases, however, of those who are to be, for example, managers of chemical works in which complex machinery is used, or managers of rolling mills, or mechanical engineers, where early and prolonged workshop experience is all-important, the theoretical training should be completed at not later than 19 years of age, when the works must be entered, and the scientific education carried further by private study or by such other means as do not interfere with the practical work of their callings. Many colleges of the class to which we have referred have already arranged their courses to meet these requirements, and some of them, as will appear from our reports of visits, have workshops for the purpose of familiarizing the students with the use of machine and hand tools.

Colleges suffer from want of funds.

It is to be regretted that nearly all of these very useful institutions suffer more or less from the want of adequate funds to enable them to provide for such a staff of professors as is necessary for the proper subdivision of the various subjects taught, and for the equipment of museums, apparatus, and laboratories of the various kinds essential to the practical instruction of the student. In this respect the provision in this country compares most unfavourably with that in the Universities and Polytechnic Schools of the Continent, even in spite of recent munificent benefactions like those of the late Mr. Charles Beyer of Manchester, the late Sir Josiah Mason of Birmingham, of the Baxter family at Dundee, the late Mr. Harris of Preston, the liberal gifts of Mr. Crawford to the Queen's College at Cork, and others. In speaking of benefactions, we do not overlook the noble endowment of Sir Joseph Whitworth for the encouragement of engineering by affording to able and promising young men, especially of the class of artizans, the means of obtaining theoretical combined with practical training —the former, in institutions of the kind we have referred to.

Secondary schools as a preparation for technical schools.

Many more required.

Progress delayed by abolition of Endowed Schools Commission.

The best preparation for technical study is a good modern secondary school of the types of the Manchester Grammar School, the Bedford Modern School, and the Allan Glen's Institution at Glasgow. Unfortunately our middle classes are at a great disadvantage compared with those of the Continent for want of a sufficient number of such schools. The transfer of the functions of the Endowed Schools Commissioners to the Charity Commissioners has not had the effect of increasing the rate of progress in the reorganization of our secondary schools. We consider it to be essential that steps should be taken to ensure that this work shall be carried on with greater vigour in the future than it has been hitherto. We learn that there are still endowments available for education, amounting to upwards of 200,000*l.* per annum, which have not been dealt with by the Commissioners. In the schemes for the new schools, the subjects of science and modern languages should form a very prominent part; and it would be desirable in

some of these schools, especially in large towns (where classical schools are not wanting) in order to provide for the fuller teaching of these subjects, more particularly of mathematics, that the classical languages should be altogether excluded from the schemes of instruction. But the existing endowments are very unevenly distributed over the country; in many of the large manufacturing centres no resources of the kind exist; private enterprise is clearly inadequate to do all that is required in establishing such schools, and we must look to some public measure to supply this, the greatest defect of our educational system. It is to be desired that in the proposed reorganization of local government, power should be given to important local bodies like the proposed County Boards and the municipal corporations, to originate and support secondary and technical schools in conformity with the public opinion, for the time being, of their constituents.

Necessity for legislation.

Localities to have power to found and support technical and secondary schools.

Intelligent youths of the artizan classes should have easy access to secondary and technical schools by numerous scholarships, and the more promising students of them again to the higher technical colleges.

Scholarships from elementary schools.

For the great mass of our working population, who must necessarily begin to earn their livelihood at an early age, and from whom our foremen will be mostly selected, it is essential that instruction in the rudiments of the sciences bearing upon industry should form a part of the curriculum of the elementary schools, and that instruction in drawing, and more especially in drawing with rule and compass, of a character likely to be useful to them in their future occupations as workmen and artizans, should receive far greater attention than it does at present. The importance of the first of these subjects has so far been acknowledged by the Education Department, that in all infant schools, simple lessons on objects and the more commonly occurring phenomena of nature, have been made obligatory. This system of instruction, if properly illustrated by the exhibition of the object itself, or of diagrams or models of the same, or by the simplest kinds of experiments, is an excellent foundation for the subsequent teaching of elementary science.

Technical instruction for workmen.

Science teaching in the elementary school.

Object lessons in infant schools.

When, however, the child enters the elementary school, the teaching of science practically ceases until it reaches the upper division, inasmuch as the arrangement of the class subjects in the lower division is found in practice to exclude science from that division; only two subjects being allowed, of which "English" must be one, and "geography" may be another; this latter being generally preferred to the alternative subject of "elementary science." It appears to us that geography, if properly taught, is a branch of elementary science which need not be separated from science generally, and can well be taught along with the other branches of science, by means of the object lessons, which are described in the Code. Thus there would be only two class subjects instead of three, and in this way the connecting link which is now wanting between science as taught in the infant

Defects in present system as regards science teaching.

Geography should be constituted an elementary science subject.

school and in the higher division of the elementary school would be supplied.

Instruction in science by special teachers.

We could hardly overstate our appreciation of the value of the plan of giving instruction in natural science by special teachers as carried out in the board schools of Liverpool and Birmingham, where the employment of a well-qualified science demonstrator ensures the sound character of the instruction, whilst the repetition of the lesson by the schoolmaster enables him to improve himself in the methods of science teaching. This should, however, be supplemented by the establishment of higher elementary schools like those of Sheffield and Manchester, into which the more advanced pupils of the primary schools may be drafted, especially if the parents of those children should be able to keep them at school up to the age of 14 or 15 unassisted, or, if they are unable to do so, assisted by scholarships taking the place of the wages which they would otherwise earn. In these latter schools it is possible to provide efficient laboratories in which practical work is performed by the pupils, whilst this cannot adequately be done for the ordinary primary schools. Youths having the advantage of such instruction will be well prepared to avail themselves at a later period of the classes of the Science and Art Department and of the technical classes under the auspices of the City and Guilds Institute, which are now so numerous, and many of which are under excellent teachers.

Higher elementary schools.

To be succeeded by science and art and technical classes.

The evidence given before us leaves no doubt that the directors of both these institutions use every effort in their power to secure sound and practical teaching in these classes, so far as that can be effected by assistance in training the teachers, and by careful testing in their examinations of the results of the instruction given. In regard to the first, much is to be hoped for from the increasing number of teachers who are now able to take advantage of the high scientific instruction given in the Normal School of Science at South Kensington, as well as from the pecuniary assistance offered by the Science and Art Department to science teachers desirous of attending the courses and laboratories of various provincial colleges; whilst for teachers of technology a great step in advance will be made when the Central Institution of the City Guilds is in operation. As to the latter, that is to say, the thoroughness of the instruction given in the classes, more close and frequent inspection than at present is much to be desired; a higher payment for the more advanced grades of several subjects should be made, than is now the case; and practical laboratory work in the higher grades in science should be more generally demanded.

Inspection should be more frequent. Higher grades better remunerated and practical work more encouraged.

Proper apparatus should be provided.

An important point to which the attention of the inspectors should be more particularly directed, is to ascertain that proper apparatus and appliances are provided for practical work in these classes.

Art schools for artizans.

With reference to the subject of drawing, we cannot too often call attention to the extraordinary efforts which are being made abroad for instruction in art, more especially as applied to

industrial and decorative purposes, and to the important influence of this instruction in furnishing employment for artisans on the Continent. Without depreciating what has been done in this direction by the schools and classes under the auspices of the Science and Art Department in this country, and whilst fully alive to the importance of the organization which tends to the diffusion of art instruction over a wide area, your Commissioners cannot conceal from themselves the fact that their influence on industrial art in this country is far from being so great as that of similar schools abroad. This is due, no doubt, to some extent to the want of proper and sufficient preparation on the part of the students, owing to the inadequate instruction they have received in drawing in the elementary schools.

Inadequate preparation for these in drawing in elementary schools.

Your Commissioners are aware that the number of children who are supposed to learn drawing in elementary schools is considerable, but it is small compared with the total number in attendance, and it is, we have reason to believe, diminishing. We have ascertained by inspection that the instruction is in far too many cases of little value. Instead of a mass of inferior drawings being sent up once a year to South Kensington for examination there, it is necessary that the instruction in drawing in elementary schools should be as carefully supervised on the spot by the Whitehall Inspectors as is that in other branches of primary education. In nearly all the places abroad which your Commissioners have visited they have found that drawing is an obligatory subject of instruction in the primary school, and that it is regarded as of equal importance with writing. The number of hours which the children devote to lessons in drawing abroad is frequently as many as three per week, whereas in England the subject is not only not obligatory, but in about three-fourths of our elementary schools no instruction whatever is given in this subject, and in those schools in which drawing is taught, the time devoted to it rarely exceeds one hour per week, and even that not always regularly. This want of attention, together with the absence of competent teachers, proper models and methods, and adequate inspection, fully accounts for the inferiority to which we have referred. The training of teachers for the Irish national schools includes special instruction in drawing, and a grant for drawing is made to primary schools in Ireland by the Commissioners of National Education. The drawing in some of the schools of the Christian Brothers, and in some of those under the Board of Intermediate Education, is good.

Comparison of drawing-instruction in elementary schools at home and abroad.

Your Commissioners are of opinion that sound instruction in the rudiments of drawing should be incorporated with writing, in all primary schools, both for girls and boys, by which, also, according to the experience of competent authorities, the writing would be much improved. Something in this direction has already been done in many good infant schools, where children of the age of six draw triangles, squares, oblongs, &c., on their slates. This exercise is repeated on the day of inspection and is taken into account in estimating the d to "appropriate occupations."

Drawing should be made compulsory.

Importance of drawing to scale.

We have observed with satisfaction the recent circular (Art Form, No. 1194) of August 1883, prescribing the new exercise of drawing to scale. We believe the principle therein laid down to be excellent, and we trust that the school managers and teachers will avail themselves of the advantages offered to them in this alteration in the First Grade work. The permission recently accorded to teachers to give instruction in drawing and modelling to the children of the elementary schools, out of the ordinary school hours, is also likely to prove very advantageous.

Drawing may be taught out of school hours.

Modelling.

We are of opinion that more attention than has hitherto been devoted to it, should be directed to the subject of modelling, in the elementary school. We notice that by a recent addition to the Art Directory small classes in modelling may now claim a local examination; we believe this to be a most salutary regulation. Modelling is an exercise of great importance to the future workman, and its rudiments can well be taken up, as in Continental schools, at the earliest age.

Assuming such preparation in the infant and elementary school as we have here suggested, the progress of subsequent instruction in art classes would be immeasurably more rapid. Whether the attendance in any given locality will ever be so great in this country, where the instruction has to be paid for, as in France, Belgium, and elsewhere, where it is gratuitous, is a matter for grave doubt. However this may be, there are two points in connection with the instruction in art schools and classes as bearing on industrial pursuits, which require careful attention.

Rapidity and boldness in freehand drawing to be encouraged, and modelling to be attended to.

Teaching of applied art.

The first is one which we are glad to perceive is now fully appreciated by the Science and Art Department, viz., the advantage of substituting practice in rapid, but correct, execution, in place of the method of stippling, which was formerly not sufficiently discouraged in art schools and classes; greater attention also than hitherto should be given to modelling. The second point relates to industrial designing. This, for a variety of reasons, the chief of which are the want of sufficient knowledge of manufactures on the part of the art teachers and the absence of sympathy evinced by the proprietors of industrial works, has, with some notable exceptions, not received sufficient attention in our art schools and classes. In fact, there has been a great departure in this respect from the intention with which the "Schools of Design" were originally founded, viz., "the practical application of (a knowledge "of) ornamental art to the improvement of manufactures." Large grants of public money for teaching art to artizans in such classes can scarcely be justified on any other ground than its industrial utility.

Grants for applied art work.

On the subject of the teaching of industrial design, we are of opinion that the Science and Art Department may with advantage depart from their principle, as at first laid down, of granting encouragement to design only,—so far as to award grants for specimens of applied art-workmanship in the materials themselves, as a test of the applicability of the design and as a reward for success in overcoming the technical difficulties of the manufacture.

It seems scarcely fair that well executed art-work by a student, say a richly chased piece of silver plate, should obtain only the same recompense as the design for the same object on paper. We are aware that special vigilance would in this case be required in order to prevent the use of such rewards for trade or for other than educational purposes.

Examination of applied art work.

It appears from the evidence, with which we include a remarkable letter from M. Willms, the eminent designer of Birmingham, that it would be well if persons practically acquainted with the application of design to industrial manufactures were more extensively consulted in the award of prizes for industrial design. We are aware that this is now done in some measure, but, however eminent may be the gentlemen whom the Department has been in the habit of consulting, it is unlikely that the small number of these should be sufficiently familiar with the vast varieties of "applications" to have the special knowledge requisite for judges in the large number of trades in which design forms an important element.

Value of local industrial art museums in stimulating artistic progress.

Amongst the most important means of stimulating industrial art education and of spreading a knowledge and appreciation of art throughout the country, is the foundation of local museums of applied art of such a character as is best adapted to advance the industries of the districts in which they are situated.

Provincial industrial art museums.

Stimulated by the advice and influence of the Director of the South Kensington Museum, and with the liberal aid of private benefactors, such collections have been provided in the local art museums at Sheffield, Derby, York, and elsewhere. In Manchester also, steps have been taken to found an industrial museum, and the Corporation has acquired the famous Bock collection of textile fabrics for this purpose. The Manchester, Birmingham, Stoke, and other galleries are open on Sundays, and are visited by increasing numbers of orderly working people. It is very desirable that similar facilities should be provided for the inspection of our metropolitan museums and collections. We are of opinion that the connection between these museums and the local schools of art should be of an intimate character. Indeed, in this respect much may be learned from foreign countries where many such museums exist and exert great influence on manufactures. Further we must express strong approval, in which we merely repeat the opinion offered by competent witnesses both at home and abroad, of the system of circulating among the local museums collections of works of art from the national collection at South Kensington. The value and utility of these collections are greatly enhanced by suitable manuals and guide books well illustrated and sold at a cheap rate. These serve to explain to visitors of the artizan classes the features most worthy of notice.

Circulating collections and manuals.

Grant of objects to provincial museums.

Whilst we fully admit the force of the contention that the contributions of the State to the foundation and maintenance of museums will be of the greatest service to the country at large, if applied mainly to central institutions. [illegible] of the metro-

polis, of Edinburgh, and of Dublin, we highly approve of the grants to provincial museums of reproductions, either gratuitously, or at a very low price. Those grants may even, in the case of typical museums situated in some of the chief industrial centres, be extended with advantage to original examples of art, and of manufactures, calculated to increase the knowledge and improve the taste of those (more especially of the artizans) engaged therein.

Government building grants require revision.

Your Commissioners believe that the grants now made in aid of the buildings for local schools of science and art and for industrial museums in connection with them, limited as they are to a maximum of 500*l.* for art schools and the same sum for science schools, coupled also with the requirements that they shall be given only for buildings under the Free Libraries Act, or in connection with schools of art, require revision, and tend rather to discourage local effort than otherwise; inasmuch as they give an erroneous impression of what is really required in order that suitable buildings may be provided.

Substitution of scholarships for Queen's prizes.

Your Commissioners highly approve of the recent foundation of scholarships to promising students in the science classes of the Science and Art Department, enabling them to continue their education at various higher schools. The limitation of the available funds appears to have rendered necessary in consequence of this step, the abolition of the Queen's Prizes, given for success in the elementary stages, and the substitution of honorary certificates in place of them. We find there is an opinion prevalent that these certificates will not afford sufficient stimulus to certain students. It is to be hoped, however, that a small addition to the customary local prize funds will be readily subscribed to supply this deficiency.

Effect of active interest taken by employers in science and art teaching.

But all these institutions and measures will not alone accomplish the object aimed at. For this the localities must rely far more than has been the case hitherto on their own exertions. Teachers should know that they labour under the eye of those who are interested in the work being thoroughly and conscientiously done. The organization and efficiency of the science schools at Oldham and Keighley are conspicuous examples of what may be done in regard to the scientific and technical instruction of artizans where local employers take an active and intelligent interest in the work. The Oldham School of Science and Art may, so far as science teaching is concerned, be regarded as the type and example of what evening schools should be; and the existence of similar efficient and flourishing schools in all our industrial towns would greatly contribute to confirm our industrial position. The remuneration of teachers should not depend to so great an extent as at present on the grants from head-quarters. School Boards should be authorised to establish and conduct science and art classes for artizans, and, where no school boards exist, power should be given to the local governing bodies to establish or support such schools. If the teaching is not entirely gratuitous (and the regularity of attendance in the art classes in the French and Belgian cities, and in the science classes in Liége, Seraing, and elsewhere

School Boards should establish science and art classes for artizans.

Fees to be low.

shows that it is a prejudice to suppose that people only appreciate what they pay for), the fees ought to be on the lowest possible scale.

"Tradesmen" teachers for workmen.

Your Commissioners have had before them deputations of representative working men who have expressed their views on the wants of the working classes with respect to the teaching of science and art, and who have stated that the assistance afforded by the Department is not sufficiently directed towards the requirements of their several trades. We believe that many workmen are disposed to attach too little value to the importance of acquiring a knowledge of the principles of science, because they do not see their application; we are of opinion that whenever it is possible persons engaged in the trade taught and having scientific knowledge should give instruction to workmen, and we have ascertained that a large number of such teachers are registered under the Examination Scheme of the City and Guilds of London Institute. We visited classes of this character at the Polytechnic Institution in Regent Street, at the Manchester Technical School, the Lyceum at Oldham, and at other places, some of which were excellent.

Technical teaching.

The City guilds are trying a most important experiment in their practical classes. If empiricism be avoided, a great point will be gained by the attraction to working men and women of a mode of instruction in which the direct application of scientific principles is the means by which a knowledge of those principles is conveyed to their minds. As to this point, we refer to the almost unanimous expression of opinion contained in the letters of eminent manufacturers in reply to our circular asking their advice as to the best means of promoting technical instruction (see Appendix, Vol. III.).

Museums attached to elementary schools abroad.

We cannot dismiss this branch of the subject without calling attention to the educational value of the museums of natural objects now found in many of the modern elementary schools of the Continent. Probably the best examples of such collections are those of the Normal School of Brussels and of the elementary schools of Zurich. Collections of natural objects, pictures, and diagrams, are of the greatest assistance for illustrating object lessons in rudimentary science to children of the earliest years.*

Desirable at home.

School libraries.

Many persons who have paid attention to the working of free libraries in our large towns are of opinion that the benefit of these might be extended to elementary schools, by placing at the disposal of such schools, books of a character calculated to interest children of school age. Amongst these books some suitable technical works, especially illustrated ones, might be included. These school libraries would be of the nature of the branch libraries which are now attached to many of the free libraries of our large towns.

Workshop instruction.

Your Commissioners, after having had the opportunity of further considering the value of manual work as a part of

* A report to the Minister of Public Instruction, just received, proposing the establishment of art museums in all the public schools of France, will be found in the Appendix.

primary instruction, and after having seen such work introduced into elementary schools of various grades in other countries besides France, are able now to express a stronger opinion in its favour than at the time of their First Report. They do this with greater confidence because, in consequence partly of the suggestion contained in that report, the experiment of introducing manual work into primary schools has been successfully effected by at least two School Boards in this country, viz., those of Manchester and Sheffield. Your Commissioners have had the opportunity of inspecting the manual work of the pupils both at the Manchester Board schools and at the Central School in Sheffield, and they are satisfied that such work is very beneficial as a part of the preliminary education of boys in this country who are to be subsequently engaged in industrial pursuits, even though it should not, as, however, it probably will do, actually shorten the period of their apprenticeship.

Beneficial effects of manual work.

Your Commissioners see no reason why, since grants are made on needlework in girls' schools, they should not be made on manual work in boys' schools. This instruction may be given so as not to interfere with the ordinary work of the school. It has been proved that this can be done, the boys being most eager to return for handicraft teaching after school hours.

Grants for manual work.

Whenever more attention shall be given to drawing, and especially to mechanical and geometrical drawing, in the ordinary and the higher elementary schools, it will be proper and desirable that the work executed in the shops attached to these schools should be made from drawings prepared by the children themselves.

Connection between drawing and manual work.

We need scarcely say that the success, not only of technical, but of the ordinary elementary instruction of our working population, depends upon the regular attendance of the children at school, and upon their remaining there sufficiently long to ensure that the knowledge acquired shall leave some lasting impression on their minds. As will have appeared from other parts of this report, the children of the workpeople of Germany and Switzerland, with few exceptions, remain at school till the age of 14 years, and in some of the German States are required to continue their elementary instruction two years longer, in evening and Sunday schools, if their examination at 14 has not been satisfactory. The wages of the parents in these countries are generally lower, and the sacrifice of their children's earnings is consequently felt more than with us. The efficiency of the American workmen is mainly attributed, by all who have inquired into the subject, to the primary education acquired by them during a prolonged attendance at school. In our own country great diversity prevails as to the standard authorising the employment of children as full-timers. In Scotland this will be remedied by the Act of last session. After next year no child, under the age of 14 years, can be employed on full time in Scotland unless it has passed the Fifth Standard. We have no doubt that all classes interested in industry will quickly reap the

Attendance at Elementary Schools.

Provisions of Scotch law as to full-time employment should be made universal.

benefit of this amendment of the law, and we see no reason why this regulation should not be extended to England and Wales, so far as it applies to factories and workshops.

Value of existing colleges and their teaching.

We have avoided, in the foregoing statement, making special observations on the merits or defects of the various scientific and technical colleges and schools which are at work or in course of establishment in this country, but we think it due to those who have founded and those who are conducting these excellent institutions to state that all of them, in each of the three divisions of the United Kingdom, are, in spite of limited means, producing good results. It is most praiseworthy on the part of the professors and teachers that they devote themselves to the important work of tuition for salaries so small as those which they as a rule receive, when many would, by employing their scientific and technical knowledge in private enterprise, obtain much larger pecuniary remuneration. We may remark concerning the colleges that it is not necessary that all of them should be of the highest type. To enable the relatively small number of persons capable of occupying the highest industrial positions to acquire the most complete education of which modern science admits, only a few well equipped institutions of high rank are needed. It is, however, of national importance that these few should be placed in such a position of efficiency as to enable them to carry out successfully the highest educational work in the special direction for which circumstances, particularly of locality, have fitted them; your Commissioners believe that no portion of the national expenditure on education is of greater importance than that employed in the scientific culture of the leaders of industry.

Colleges should be of various grades.

Value of the highest scientific training not yet sufficiently recognised.

Your Commissioners fear that the belief in the efficacy of training of this *highest* character, is, in England, at present small amongst those whom it will ultimately benefit; and yet there are few countries in which so many investigations have been made, the practical bearings of which were not at the outset apparent, but which have in the end led to the most important practical results. The discovery by Faraday of magneto-electricity, and by Joule of the mechanical equivalent of heat, at once occur as examples. The Englishman is accustomed to seek for an immediate return; and has yet to learn that an extended and systematic education up to, and including, the methods of original research, is now a necessary preliminary to the fullest development of industry. It is, amongst other elements of progress, to the gradual but sure growth of public opinion in this direction, that your Commissioners look for the means of securing to this country in the future, as in the past, the highest position as an industrial nation.

Importance of original research.

Weaving schools and mechanical laboratories.

We desire to express our satisfaction at the recent establishment of weaving and dyeing schools in the north of England, and of mechanical laboratories in several localities. The utility of weaving schools to proprietors and managers of factories, and to merchants who desire to become acquainted with the processes of the manufacture of the goods in which

they deal, has been so clearly demonstrated on the Continent, that we need adduce no further arguments in their favour. The weaving and dyeing schools of Leeds have been established and are maintained entirely by the Clothworkers' Company of London. We regard this as one of the most useful and appropriate purposes to which a portion of their funds could have been devoted. The mechanical laboratories and mechanical drawing schools at Nottingham, Sheffield, Huddersfield, and elsewhere, will be of the greatest service in enlarging the knowledge and experience of young artisans who are kept continuously at one branch in their daily work.

Science and art in Training Colleges.

The teaching of art and science subjects, in the Training Colleges of Great Britain for elementary school teachers, is very defective. The inspection on the part of the Science and Art Department has, until lately, been greatly neglected, owing to the divided responsibility for the Colleges, of the Education Department and the Kensington authorities. The answers received by the examiners to such questions as the following—"Write out the heads of a lecture "to an elementary class on the chemical and physical properties of "water, mentioning the experiments which you would show, and "your object in showing them," prove conclusively that the students have no idea as to how such a simple matter ought to be brought before a class. It would greatly conduce to sound and efficient training in science, and particularly in the methods of teaching, if those students in training who have shown an aptitude for science work could be sent annually to the Normal School of Science at South Kensington, or to other approved efficient institutions. The provision for art-teaching in most of the Training Colleges is inferior even to that at present made for science, and an entire reform in this respect is urgently needed; and similar measures should be taken for systematic instruction in art as in science. Considerable attention is, as we have said elsewhere, paid to drawing in the Normal School in Dublin, where it is taught by a competent art-master.

School Boards are making endeavours to improve education of pupil teachers.

The School Boards of our great cities are fully alive to the defective character of the instruction of pupil-teachers. In London, Liverpool, and elsewhere, they have endeavoured to apply a partial remedy by introducing joint instruction, under special teachers, qualified in each subject, instead of having each headmaster to instruct the pupil teachers of his own school in every subject. The Education Department has also taken a small step in the right direction, by somewhat limiting the number of hours that the pupils may be employed in teaching, so as to give them a little more leisure for learning. No considerable improvement can, however, be expected until the great school boards are authorised to establish colleges for training teachers. These colleges would be day schools and need not receive from the State enormous capitation grants like those now given to the English denominational Training Colleges, but only small allowances like those granted to the day students in those of Scotland.

Day Training Colleges.

City and Guilds of London Institute.

In concluding this part of our subject, we deem ourselves justified in giving, at the risk of repeating some of the statements we may have made in the earlier parts of our report, a short review of the work initiated, controlled, and contemplated by the City and Guilds of London Institute, inasmuch as this important organization has been created in order to promote the technical instruction of persons of every grade engaged in industry.

The Institute had not been in existence very long when your Commissioners were appointed, and consequently they have scarcely had the opportunity of estimating the value of the work it is doing in some of its branches. Even now that work is in many parts of the kingdom unknown, and this is particularly the case in Ireland. In Dublin, Cork, and in many other Irish towns, nothing was known at the time of our visit of the encouragement to technical instruction offered by the Institute's scheme of technological examinations, whereas in Belfast advantage has been taken of it; and the establishment there of a technical school, for instruction in the weaving and dyeing of linen, and in mechanical engineering, is largely due to its action.

Central Institution.

The Central Institution, which is not yet opened, is intended by the Institute to fulfil functions resembling those of the great Polytechnic Schools of the Continent. Your Commissioners have examined the proposed scheme of instruction embodied in the Report of the Institute, and they have also inspected the building, which is nearly complete. They consider that, as the number of technical classes and technical schools increases, as it is likely to do, the want of such an institution as that in Exhibition Road for the training of teachers will be more and more felt. It will be of great advantage as a technical high school for the metropolis, which is, in fact, one of our greatest industrial centres. It is intended to afford additional facilities for the prosecution of original research in science. In order, however, that the Institution may effect the purpose for which it is intended, it should be well endowed, both for the provision of adequate special instruction, and also for the establishment of exhibitions to defray the cost of maintenance of poor students whilst pursuing their studies. Without expressing any positive opinion as to the amount required for this purpose, your Commissioners fear that the annual sum at present subscribed by the Livery Companies is inadequate to the future requirements of the Institution.

Its endowment.

Finsbury Technical College. Evening classes.

As regards the Finsbury Technical College, your Commissioners believe that the evening classes connected with it are giving valuable technical instruction, such as is greatly needed by the artizans of the district in which the school is situated. The practical laboratory instruction in the applications of electricity to trade purposes is worthy of special mention.

Day school.

The programme of the day school is well devised, and the offer of scholarships to the principal middle class schools of the metropolis, which enable select pupils therefrom to continue their education at the Finsbury College, is a good feature in the scheme. Considering the want that is generally felt of good trade

schools into which promising pupils from the upper standards of the public elementary schools may be drafted, your Commissioners are of opinion that a more intimate connection of the day department of the Finsbury Technical College with the elementary schools would also be desirable.

Want of similar schools in other parts of London.

We think that similar trade schools, in which the curriculum consists mainly of practical science teaching, workshop instruction, drawing, and modern languages, might with advantage be established in other parts of London.

South London Technical Art School.

Your Commissioners examined with great interest the work of the South London Technical Art School. The teaching of this school has had a direct bearing upon the important manufacturing works of Messrs. Doulton; and in few cases have we been able more definitely to ascertain the extent to which technical instruction has benefited a local industry. In many other branches besides that of the manufacture and painting of pottery, the teaching of design in connection with the material to which it is to be applied, would be undoubtedly advantageous. In this school practical instruction is also given in wood engraving, and a class is about to be formed in enamelling; the City and Guilds of London Institute might usefully extend this kind of teaching in other directions.

Technological classes in the country.

By means of the Institute's scheme of technological examinations, classes have been formed in all the large manufacturing towns, in which the instruction is more specialised, according to the requirements of persons engaged in different industries, than has been thought desirable in the State-aided classes which are held under the direction of the Science and Art Department. It will be seen by the collection of letters from eminent manufacturers in the Appendix, that classes of the former kind are greatly valued and regarded as deserving of continued encouragement.

Practical tests.

The regulation of the Institute which restricts the payment on results to the case of candidates engaged in the industries to which the examination refers, is a good one; and the introduction of practical tests and the importance which the Institute attaches to preliminary science-knowledge, and to skill in drawing, are to be commended.

Rapid increase in the number of candidates.

From the rapid increase in the number of candidates for these examinations during the last four years (the number in 1879 having been 202, and in 1883, 2,397), it may be assumed that, as they become more generally known, that number will still further increase, and that much larger funds will be required in payment to teachers on results.

Grants to technical schools in the manufacturing districts.

We consider that the Institute has rendered efficient service to technical education by means of the contributions it has given to the establishment of technical schools in the great centres of manufacturing industry, where they are even more necessary than in the metropolis. The Institute appears to have distributed its grants with judgment and discretion, and in many cases, notably in Nottingham, Manchester, Sheffield, and Leicester, its contributions have had the effect of stimulating local effort in the establishment of new technical classes.

Your Commissioners are able generally to endorse the several schemes of technical instruction, now in operation or about to be carried on by the City and Guilds of London Institute; and, in view of the efficient and permanent working of these schemes, we should be glad to see the funds of the Institute made fully adequate to the efficient carrying out of the objects it has in view, which in our opinion is not yet the case. We think it is of importance that the grants made by the contributing Livery Companies should be placed upon a permanent basis.

Funds should be increased and placed on a permanent basis.

Whilst the preceding remarks apply to the United Kingdom as a whole, including those portions of Ireland, and more especially of the province of Ulster, in which the factory system is fully developed, other portions of the latter country require to be separately considered. In saying this, we refer more particularly to the poor and remote districts of the West.

Ireland.

Before proceeding to this part of the subject, however, we would refer very shortly to the question of technical instruction suitable for foremen and workmen in Dublin. Whilst science and art classes, many of them very successful, are to be found in several of the important towns of Ireland, there are scarcely any science classes at work in Dublin. Various reasons were assigned to us for this state of things, some of them of a kind into which it is not expedient that we should enter. At the same time, there is in Dublin the Royal College of Science, with a staff of competent professors, an admirable technical museum, and laboratories fairly well equipped for practical work. It appears from the evidence that of the small number of students who follow a complete course of instruction in this institution, about one-half are Englishmen, holders of the Royal Exhibitions of the Science and Art Department, scarcely any of whom become teachers of science in Ireland. There are no short summer courses at the College, like those at the Normal School at South Kensington, for the instruction of science teachers. There are we are aware some courses of evening lectures, but although the laboratories of the College are the only ones in Dublin available for practical evening instruction, such instruction in science and in mechanical drawing forms no part of the arrangements of the college. It appears that by the rules of the Science and Art Department, the professors of the College cannot earn grants on the results of instruction in science, as would be the case if they were ordinary science teachers. We are of opinion that so long as the effective work of the College in preparing associate students, and more particularly Irish students, is so limited in area as at present, evening classes with practical laboratory work should form a part of the regular College courses, and that the remuneration of the professors should depend in part on the success, or at any rate on the regular attendance, of students at such classes.

Technical instruction in Dublin.

Royal College of Science, Dublin.

Evening science classes.

We would also remark that we have received evidence of a very contradictory nature as to the teaching of science in Irish Intermediate Schools. We believe, however,

Science in Irish Intermediate Schools.

engaging the attention of the Board of Intermediate Education, and we only deem it necessary to state in reference to this subject, that efficient instruction in science will not be possible in those schools unless they are provided with proper laboratories, which in most, if not in all of them, are at present entirely wanting.

But the most important part of our task with regard to Ireland, is to consider the possibility of improving the industrial conditions of the poor and remote districts of the West, by means of technical education.

Books used in Irish National Schools.

By the courtesy of Sir Patrick Keenan, K.C.M.G., the Resident Commissioner of National Education in Ireland, your Commissioners have been furnished with what they understood to be a complete set of the books used in the Irish National Schools. They find that these books are well adapted for the literary instruction of the children of various ages in those schools, and that they contain much interesting information on the natural features and resources of Ireland. But, except as to agriculture, they do not afford adequate assistance towards graduated instruction in industrial processes, or in the rudiments of the sciences on which those processes are founded. As the Irish National Education Commissioners are by their regulations mainly responsible for the selection of the books used in the schools, this defect should receive their early attention.

These books need to be revised so as to afford means of instruction in rudimentary science.

Home industries.

There is a general consensus of opinion on the part of persons of all ranks in that country, whatever may be their views on other subjects, that the prosperity of the poorer districts of Ireland may be greatly promoted by technical instruction in handicrafts and in home industries. There is a conviction not less general, and it is one which our visits have fully confirmed in our minds, that the children and young people of Ireland of the labouring class possess great manual dexterity and aptitude, which only requires to be developed in order to be useful to themselves and to those amongst whom they live. As evidence of this, we need only refer to the remarkable success of the Christian Brothers, and to that of the ladies of Religious Orders, in training children and young persons for handicrafts, in Industrial Schools and Institutions of a like nature. There appears to be no reason why similar instruction to that which is given in these schools should not be given elsewhere, if the necessary funds and teachers are forthcoming. We have shown that instruction of this kind given on the Continent to persons in remote districts, who would otherwise be idle, has added materially to their resources, both directly, and by training them for employment in larger industrial concerns, and we have ascertained that no great expenditure of public money has been required in order to produce these effects.

Manual dexterity of Irish people.

Not only is instruction of this kind deemed to be desirable, but we have found that there is a willingness on the part of benevolent persons in Ireland to assist its promotion by subscriptions and in other ways. It is true that by some it has been proposed that the Government should itself initiate, if it did not entirely charge itself with this work, but we were happy to find there were others who

Teaching of home industries to be founded by localities

would be quite satisfied if its utility received the imprimatur of the Government, and if the State offered rewards for the ascertained results of instruction of this kind. We are of opinion that successful work of this nature, whether it be conducted by individuals or societies or by religious bodies, deserves the recognition and reward of the Government. We think it no part of our duty to state which are the home industries best adapted to the conditions of different parts of Ireland. Each locality will be able to form its own judgment in regard to this, and due weight should be given by the Government to such local expression of opinion; payment in all cases being dependent upon the results obtained in the schools or classes. We do not think it would be possible for the Government to train teachers for a variety of home industries, but it might contribute to the payment of such teachers appointed by the localities; and it would be expedient to establish a class of itinerant teachers for service in districts where resident instructors cannot be maintained.

and aided by the Government.

Grants to teachers of home industries.

Travelling teachers.

These suggestions apply even in a greater degree to the instruction of girls than of boys.

We need scarcely point out that, if it be deemed desirable to introduce manual instruction in the use of tools in elementary schools at all, this would apply in an eminent degree to the primary schools of Ireland. It was stated in evidence before us that in some parts of Ireland, ordinary handicrafts, like those of the mason, have become absolutely extinct. Whether the children remain in their own immediate localities or migrate to other parts of the country, or emigrate to our colonies or to foreign countries, such instruction leading up to their apprenticeship as skilled labourers, instead of their fulfilling, as is now too much the case, the part of mere hewers of wood and drawers of water, would be of the greatest value to them. We are happy to find that the authorities of the National Board of Education in Ireland appreciate the importance of introducing instruction in manual work into their schools. They have already begun to give instruction of this kind to some few of their teachers, with a view to qualify them for imparting it to the children in the schools; but, in order that this instruction may be satisfactory, it is important that the training of the teachers themselves should be systematic and thorough; and, obvious as this might appear to be, we do not hesitate to impress it upon the minds of the authorities of the National Board. Until the teachers are able themselves to give the instruction, it might be given by skilled and intelligent artizans. We have reason to believe that, whenever efficient teachers can be found, the National Board will be prepared to pay for the results of manual teaching in the primary schools. It is scarcely necessary to say that our statement with regard to drawing, in reference to schools generally, applies with equal force to the Irish schools. We may remark that the progress of children in learning home trades will be much more satisfactory if they have been trained at school in the use of the ordinary tools for working in wood and iron, and in drawing.

Instruction in the use of tools in Irish primary schools.

Training of teachers for this purpose to be thorough.

Artizans might be employed to teach.

We shall deal with instruction in agriculture in Ireland in the succeeding subsection, in which we review the separate report of Mr. Jenkins, and the evidence which we personally received in Ireland on that special branch of the subject.

Compulsory attendance in Irish primary schools.

Whilst dealing with Irish education, we cannot refrain from expressing our satisfaction at having found that public opinion amongst all classes in Ireland is in favour of some measure for gradually making primary education in that country compulsory. The subject is one surrounded with difficulties of a nature which appear to us to place the discussion of its details beyond the scope of our commission. We consider, however, that we should not do our duty if we did not express our decided opinion that no marked progress in the direction of technical education can be effected in Ireland, until primary education in that country has been placed on a proper footing.

AGRICULTURAL EDUCATION.

Agricultural education.

As stated at the commencement of this Report, your Commissioners did not think that an inquiry into the instruction of the industrial classes would be complete unless it included some notice of the instruction of the large and important class of agriculturists.

We were unable ourselves to conduct this branch of the inquiry, except partially in regard to Ireland, but we trust that those who read the Report on Agricultural Education of our Sub-Commissioner, Mr. H. M. Jenkins, the Secretary of the Royal Agricultural Society of England, submitted herewith, will think that we have been well advised in placing the inquiry in his hands. As supplementary to his Report, your Commissioners refer to the Irish evidence in the Appendix, and to the narrative of their visits to the Royal Albert College at Glasnevin, to the Munster Dairy School, and to parts of the South and West of Ireland. We have not inquired into the state of agriculture, as an art, abroad and at home; to have done this would have lengthened the inquiry beyond measure, and it was the less needed, as this branch of the question has been incidentally treated in the recent Report of the Royal Commission on Agriculture.

Influence of schools on agriculture on the Continent.

It will, however, be seen from the Report of our Sub-Commissioner that those best able to form an opinion attribute a great and beneficial influence upon the progress of agriculture to the agricultural schools of various grades of the Continent, and more especially to those like Hohenheim and Grignon, in which practice is combined with scientific teaching.

Our agriculture in a state of transition.

At a time like the present, when cheap railway and water conveyance of agricultural products from distant countries has completely changed the economical conditions of successful agriculture in Great Britain, it is of the greatest importance that those who are interested in the cultivation of the soil, whether as proprietors or as farmers, should not simply be familiar with existing practices at home, important as is such a

familiarity, but that they should understand also the reasons which have caused these practices to prevail, in order to be able to decide to what extent they should continue to be pursued. They should likewise be acquainted with the nature and mode of cultivation of crops, the rearing and feeding of cattle, and the dairy practice, of other countries.* To impart knowledge of this description is the proper function of the Agricultural School. In Great Britain, the Agricultural Department of the Normal School of South Kensington, the Royal Agricultural College of Cirencester, and the College of Downton, are the only institutions for higher agricultural education; the former principally for training teachers, the two latter for the education of landowners, land agents, and farmers. The first of these has been so short a time in existence that no definite judgment of its results can be formed by the test of practical success or failure. But we agree with our Sub-Commissioner in thinking that the complete course of four years at the Normal School is inconveniently and unnecessarily long; that at least all students who propose to become associates should on entrance prove that they possess the amount of practical knowledge of agriculture which can be acquired by a year's residence on a farm; and that visits to farms, and factories connected with agriculture, during the recess, should be encouraged and rewarded by scholarships to those who have profited by them. Our Sub-Commissioner considers that colleges like those of Cirencester and Downton do not require "propping" by the State, but that scholarships tenable at those colleges might be given by the Government to deserving students in the agricultural divisions of county schools.

Higher agricultural schools in this country.

Scholarships in the higher schools.

These agricultural divisions, which are intended by our Sub-Commissioner to provide secondary agricultural instruction, have still to be created. Mr. Jenkins proposes that farms should be attached to county schools, in which the pupils in the higher forms should be taught the principles and practice of farming, and should take part in farming operations and the management of stock. The experience of schools of this kind on the Continent, and of some isolated attempts in this country, shows that they cannot be self-supporting. He proposes that the locality (the county) should equip the school and, we suppose, the farm attached to it; and that the Government should contribute as liberally to the buildings as to those of schools of science. We can see no objection to the latter proposal, and we approve of the suggestion that the governing bodies of counties should have the power of establishing and maintaining agricultural schools, or contributing thereto, under proper conditions; we should

Secondary agricultural schools.

To be supported by counties

* The practice of growing beet-roots for the manufacture of sugar has been attended with most beneficial changes in Continental agriculture. This cultivation is carried on in countries varying remarkably in the conditions of climate in regard to heat and moisture. Should the recovery of ammonia in the manufacture of coke, and from the raw coal used in the blast furnace, be attended with the success which there is every reason to anticipate, the cheapening of nitrogenous manures may indicate some considerable changes in the agricultural practice of our own country.

and by great agricultural societies.

be glad to see this power conferred on them by the proposed measure for reorganising county government. But it would also appear to us that an active participation in the encouragement of secondary agricultural schools would be an object well worthy of our great National Agricultural Societies. Their funds have hitherto been devoted mainly to the encouragement by premiums, of improvements in cattle-breeding and in agricultural machinery. The commercial demand for animals of a high class and for implements of the best construction is now so great that any other than an honorary recognition of merit seems to be no longer required; and if a portion only of the money now distributed in prizes were offered in aid of local subscriptions for the addition of an agricultural department to the existing, and in many cases flourishing, county schools, it is probable that so desirable an experiment as that proposed by our Sub-Commissioner would very soon be carried into effect.

We are aware that the fact of the number of competitors for the Royal Agricultural Society's junior scholarships having been small may not encourage that great society to increase its efforts in the direction of agricultural education, but we believe with Mr. Jenkins that the fault lies in a great measure with the want of competent teachers, a want which is now in the course of being supplied by the Normal School of Science and otherwise.

Agricultural classes under Science and Art Department.

With respect to the classes in the "principles of agriculture" in connection with the Science and Art Department, which properly come under the head of secondary instruction, Mr. Jenkins is of opinion that "the attempt to teach the principles of a subject "without first teaching its facts and phenomena is very much "like trying to build an actual castle in the air." We quite agree in this opinion, and we consider it essential, even if it should involve some change in the programme of the Department, that the examiners should so arrange their questions as to ascertain as far as possible from his replies that the student is acquainted with the facts to which the principles are applicable, just as in chemistry, for instance, the examiner would not be satisfied with a mere knowledge of the laws affecting the combinations of chemical elements and compounds, but would expect the student to be acquainted with the nature and properties of the substances entering into combination. Unfortunately there is not the same room for a practical examination in agriculture as that which is now very properly required by the Department in other sciences. On the whole it may be expected that young men, following the profession of farmers, and acquainted with farming practice, will derive advantage from the classes in the theory of agriculture which are held in country towns.

Examination as to facts.

Farm apprentice schools.

Of our Sub-Commissioner's suggestions in regard to lower agricultural education in Great Britain, that which recommends the apprenticeship of youths to selected farmers is very important, if it can be carried out. There can be no doubt that, if competent farmers can be found willing to receive boys and girls as apprentices (the girls in the dairy), and to allow a part

of their time to be spent in continuing their school instruction, as is suggested by Mr. Jenkins, there could be no better training for the pupils. The French Fermes-écoles and German Ackerbauschulen are examples of this kind of training.

Instruction in agriculture in rural elementary schools.

His recommendations in reference to elementary schools in rural districts are more definite. We agree with him in thinking that instruction in the theory and practice of agriculture should, in Great Britain, as it already does in Ireland, after suitable introductory object lessons, form, in the upper standards, a part of the ordinary elementary subjects of rural schools, and should not be relegated to "class subjects"; and that, if time cannot otherwise be found for them, which we scarcely anticipate, some of the elementary subjects, such as the higher branches of arithmetic, should be transferred from the former to the latter category; and further, that encouragement should be given, by way of grants, to practical work on plots of land attached to such schools. One good result of this would probably be that the children, taking a more intelligent interest in farm work, would be less anxious to migrate from the country into the larger towns. It is probable that, if a demand existed for a practical knowledge of agriculture on the part of teachers in rural schools, some of the farmers' sons who at present unhealthily increase the competition for farms would qualify themselves to become elementary teachers.

Agricultural education in Ireland.

The subject of agricultural education, which is of national interest in Great Britain, is a question of life and death for Ireland; we are happy to find that this is thoroughly felt both by the Government and by the people. There is progress in all directions.

Glasnevin.

The Albert Agricultural Institution at Glasnevin, near Dublin, no longer confines itself to the instruction of young men who intend to become farmers or land agents, but is training teachers who will disseminate a knowledge of sound theory and likewise of successful practice throughout Ireland; for the Glasnevin farms, the 6-acre as well as the 100-acre, are pecuniarily successful.

Munster Dairy School.

The Munster Agricultural and Dairy School, especially its dairy department, as will appear from the evidence given before us, is ascertained and acknowledged by all classes to be rendering eminent service to the farmers of the county of Cork.

Training of teachers in Ireland.

Every elementary teacher in Ireland is required to pass an examination in agriculture, and the science and practice of agriculture are taught to all boys in the three upper standards (or classes, as they are called in Ireland) of all rural schools.

Instruction in agriculture in Irish primary schools.

Last year nearly 45,000 boys were examined in this subject. Small farms are attached to some of these schools, and special grants are made for proficiency in practical agriculture, as tested on those farms. What is most encouraging is that the authorities of the National Board themselves are not satisfied with what is being done. They are anxious that more encouragement should be given to the patrons of schools to furnish them with small example farms; they admit that when this is done, results cannot be effectively gauged by their single

More agricultural schools desirable for Ireland.

agricultural inspector, Mr. Carroll, in addition to his duties as head of the Glasnevin Institution. Your Commissioners believe that the Board would gladly see the successful experiment of the Cork dairy school repeated in other parts of Ireland, each such school being established, as at Cork, by local effort, conducted by local managers in accordance with the wants of the locality, and supported in part by local subscriptions. Your Commissioners trust that the Treasury would see its way to encourage and aid such schools by grants out of Imperial funds.

Irish workhouse schools.

The evidence shows that the members of some Boards of Guardians are not satisfied with the prevailing absence of agricultural instruction for the children in the Irish workhouses. They desire that the plots of land attached to the workhouses should be more generally used, than they now are, for this instruction.

Flax culture.

At the same time the faults of the past are acknowledged. It was stated in evidence before us that the failure to introduce the cultivation of flax in the south of Ireland was due in a great measure to the ignorance of the instructors, and to their having persuaded the people to grow it on unsuitable land, with the result of stunted crops, badly prepared, and scarcely fit for the commonest tissues. That some of the instructors were ignorant, we cannot doubt; but the example of Flanders and other countries shows that flax can be grown on the poorest soils, provided that they are liberally manured, and receive such painstaking and assiduous cultivation as the peasants of those countries bestow on them. Failures, however, like that of flax culture in the South of Ireland, will induce the promoters of agricultural education in that country to proceed with caution, and not to raise a prejudice against it by schemes for which the teachers are not qualified and the learners are not ripe.

Recommendations.

Recommendations.

Having carefully considered what is desirable and practicable in regard to the general and technical instruction of the various classes engaged in industrial pursuits in this country, we humbly offer the following recommendations, which require the intervention of the Legislature or of public departments:—

I. As to public elementary schools:

Elementary schools.

(*a.*) That rudimentary drawing be incorporated with writing as a single elementary subject, and that instruction in elementary drawing be continued throughout the standards. That the inspectors of the Education Department, Whitehall, be responsible for the instruction in drawing. That drawing from casts and models be required as part of the work, and that modelling be encouraged by grant.

(*b.*) That there be only two class subjects, instead of three, in the lower division of elementary schools, and that the object lessons for teaching elementary science shall include the subject of geography.

(*c.*) That, after reasonable notice, a school shall not be deemed to be provided with proper "apparatus of elementary instruction" under Article 115 of the Code, unless it have a proper supply of casts and models for drawing.

(*d.*) That proficiency in the use of tools for working in wood and iron be paid for as a "specific subject," arrangements being made for the work being done, so far as practicable, out of school hours. That special grants be made to schools in aid of collections of natural objects, casts, drawings, &c., suitable for school museums.

(*e.*) That in rural schools instruction in the principles and facts of agriculture, after suitable introductory object lessons, shall be made obligatory in the upper standards.

(*f.*) That the provision at present confined to Scotland, which prescribes that children under the age of 14 shall not be allowed to work as full-timers in factories and workshops unless they have passed in the Fifth Standard, be extended to England and Wales.

II. As to classes under the Science and Art Department, and grants by the Department:

Classes under Science and Art Department.

(*a.*) That school boards have power to establish, conduct, and contribute to the maintenance of classes for young persons and adults (being artizans) under the Science and Art Department. That in localities having no school board the local authority have analogous powers.

(*b.*) That the Science and Art Department shall arrange that the instruction in those science subjects which admit of it, shall be of a more practical character than it is at present, especially in the "honours" stage; that payment on results be increased in the advanced stages of all subjects, at least to the level of those now made for practical chemistry and metallurgy, and that greater encouragement be given to grouping.

(*c.*) That the examinations in agriculture be made to have a more practical bearing.

(*d.*) That metallurgy, if it be retained, be divided into groups, as (1) the precious metals, (2) those extracted from metalliferous mines, as copper, tin, lead, &c., (3) iron and steel. That mining be similarly divided into (1) coal and (2) metalliferous mining.

(*e.*) That the inspection of science classes by the Science and Art Department, with a view to ascertain the efficiency of the instruction, and of the apparatus and laboratories, be made more effective, with the assistance, where necessary, of local sub-inspectors.

(*f.*) That it shall not be a requirement of the Science and Art Department that payment of fees be demanded from artizans for instruction in the science and art classes.

(*g.*) That in the awards for industrial design more attention be paid by the Department, than is the case at present, to the applicability of the design to the material in which

it is to be executed, and that special grants be made for the actual execution of designs under proper safeguards.

(*h.*) That the limits of the Building grants, under the Science and Art Department, to 500*l.* each for schools of Art and of Science should be abolished, and the conditions attached to them be revised.

(*i.*) That, in addition to the loan of circulating collections and the grant of art reproductions at reduced cost, contributions be made to provincial industrial museums of original examples tending to advance the industries of the district in which such museums are situated.

Training Colleges for teachers.

III. Training Colleges for elementary teachers:

(*a.*) That the teaching of science and art in Training Colleges, and its inspection by the Science and Art Department, be made efficient, and that arrangements be made for giving to selected students in those Colleges greater facilities and inducements for the study of art and science in the National Art Training School and the Normal School of Science at South Kensington, the Royal College of Science for Ireland, and other Institutions of a similar class approved of by the Government.

Secondary and technical instruction.

IV. Secondary and technical instruction:

(*a.*) That steps be taken to accelerate the application of ancient endowments, under amended schemes, to secondary and technical instruction.

(*b.*) That provision be made by the Charity Commissioners for the establishment, in suitable localities, of schools, or departments of schools, in which the study of natural science, drawing, mathematics, and modern languages, shall take the place of Latin and Greek.

(*c.*) That local authorities be empowered, if they think fit, to establish, maintain, and contribute to the establishment and maintenance of secondary and technical (including agricultural) schools and colleges.

Public libraries and museums.

V. Public libraries and museums:

(*a.*) That ratepayers have power, by vote, to sanction the increase of the expenditure, under the Public Libraries Acts, beyond its present limit, and that the restriction of the Acts to localities having 5,000 inhabitants and upwards be repealed.

(*b.*) That museums of art and science and technological collections be opened to the public on Sundays.

Ireland.

VI. Special recommendations in regard to Ireland:

(*a.*) That steps be taken at the earliest possible moment for the gradual introduction of compulsory attendance at elementary schools in Ireland.

(*b.*) That payments be made by the National Board, under proper regulations, on the results of the teaching of home industries to children, young persons, and adults; as well as in aid of the salaries of industrial teachers.

(*c.*) That systematic instruction be given to primary school teachers, qualifying them to teach the use of tools for working in wood and iron, in the primary schools.

(*d.*) That steps be taken by the Commissioners of National Education in Ireland for the provision of books calculated to assist the teachers of primary schools in giving graduated lessons in rudimentary science.

(*e.*) That grants-in-aid be sanctioned by the Treasury to approved agricultural schools, and to approved schools for instruction in local industries.

(*f.*) That practical evening science classes for artisans form part of the instruction in the Royal College of Science of Ireland, in Dublin.

(*g.*) That the Board of Intermediate Education take steps to ensure the provision of adequate means for the practical teaching of science in the schools under their direction.

General recommendations.

In addition to the preceding recommendations which necessitate action on the part of the Legislature or of the public authorities, or of both, your Commissioners make the following recommendations, requiring no such action, by way of suggestions for the consideration of those in whose power it is to comply with them:—

I. That it be made a condition by employers of young persons, and by the trade organizations, in the case of industries for which an acquaintance with science or art is desirable, that such young persons requiring it, receive instruction therein either in schools attached to works or groups of works, or in such classes as may be available; the employers and trade organizations, in the latter case, contributing to the maintenance of such classes.

II. That the managers and promoters of science and technical classes should (*a*) so arrange the emoluments of teachers as to encourage them to retain their students for the advanced stages of subjects in which they have passed the elementary stage, and (*b*) that they should endeavour to group the teaching of cognate science subjects, as recommended by the Royal Commission on the Advancement of Science, and as provided for by the regulations of the Science and Art Department.

III. That scholarships be more liberally founded, especially for pupils of higher elementary schools, enabling them to proceed to higher technical schools and colleges.

IV. That the great national agricultural societies give aid to the establishment in counties of secondary schools or classes for teaching agriculture.

V. That those responsible for the management of primary schools in Ireland, in the districts where farming is defective, attach small example farms to such schools wherever it is possible; and that boards of guardians employ the plots of land attached to workhouses for the agricultural instruction of the children therein.

VI. That the subscriptions given by the liberality of the City of London and of the different Guilds, to the City and Guilds Institute, be made adequate to the fulfilment of the work which that Institute has undertaken, including the equipment and maintenance of its Central Institution.

In closing our report, we think it right to recall the fact that the first impulse to an inquiry into the subject of technical instruction was given by the important letter of Dr., now Sir Lyon Playfair, K.C.B., of May 15, 1867, to the Chairman of the Schools' Inquiry Commission, in which he called attention to the great progress in engineering and manufactures abroad, shown at the Paris Exhibition of that year. In the course of our inquiry we have received much guidance from the letter on the subject by Mr. B. Samuelson, M.P., to the Vice President of the Committee of Council on Education, dated November 16, 1867; from the report of the Select Committee of the House of Commons on Scientific Instruction, 1868; the Report of the Royal Commission on the same subject; the papers by Mr. H. M. Felkin on Chemnitz, by Messrs. McLaren and Beaumont, and various other publications.

We desire also to express our thanks to the public authorities, to the owners and managers of industrial works, and to the numerous other persons, both at home and abroad, to whom we had occasion to apply for information, for the frank and courteous manner in which it was given to us; and also to acknowledge the prompt and valuable assistance which we received from the members of our Diplomatic and Consular services in the prosecution of our inquiry. All of which we humbly beg leave to submit for Your Majesty's gracious consideration.

(Signed) B. SAMUELSON.
H. E. ROSCOE.
PHILIP MAGNUS.
JOHN SLAGG.
SWIRE SMITH.
WM. WOODALL.

GILBERT R. REDGRAVE,
Secretary,
April 4, 1884.

APPENDIX I.

Report on Schools for Teaching Domestic Trades in South Germany and the Austrian Provinces.

To the Chairman and Members of the Royal Commission on Technical Instruction.

Gentlemen,

In compliance with your request, we have travelled through some of the chief manufacturing districts of the Black Forest, and paid a visit to the Exhibition of Bavarian school work at Nuremberg, in order to inquire into the industries carried on by the peasantry in their own homes, and to study the schools and other means afforded by the Government for the furtherance and encouragement of domestic trades. Subsequently we examined a few of the Fachschulen, established by the Austrian Government for the instruction of the peasantry in various industries. On our first journey, acting on the advice of the Oberbürgermeister of Baden-Baden, Herr Gönner, who is the President of the Local School Council, we went first to Carlsruhe, the capital of the Grand Duchy of Baden, in which the chief portion of the Forest is situated. Here we had the advantage of meeting Herr Hofrath Wagner, who is the superintendent of the technical schools of the country. He explained to us the arrangement by which some of these schools are under the Minister of the Interior and Trade, and some under the Minister of Education and Justice. He advised us to see the Minister of the Interior, Herr v. Stösser, who is greatly interested in the promotion of technical education.

Visit to the Black Forest.

Austrian schools.

Proceed to Carlsruhe.

In the absence of Herr v. Stösser, we saw his private secretary, Herr Schenkel, and we had also the advantage of meeting the Chief Factory Inspector, Herr Wörishoffer. From these gentlemen we obtained a brief account of the different industries of the Forest, and a statement of what has been done by the Government for their development. The factory inspector informed us that the home industries of the country were everywhere on the decline; the various manufactures having nearly all reached the stage at which they pass from the hands of individual workmen into the control of the proprietors of small factories, employing machinery driven by water or steam power. The owners of such factories, owing to the greater subdivision of the work, can produce more cheaply than the peasant engaged in his own home. The conflict with the factory is at present a severe one, and the artizan working at home can earn only the barest livelihood, being everywhere paid less than the workman in the factory. He considered that the duty of the Government consisted in placing new and good designs before the workpeople, in keeping them constantly acquainted with what was being done by their competitors in other countries, and in assisting in the maintenance of local schools and exhibitions. He thought that State aid was very dangerously employed in granting subventions to, or in directly assisting home industries. The principal domestic industries of the forest are—

Interview with Herren Schenkel and Wörishoffer.

Conflict between factory and home industry.

The duty of the Government in relation to home industries.

Industries of the Black Forest

I. Clockmaking, chiefly carried on in the districts of Triberg, Villingen, and Neustadt.
II. Straw-plaiting.—Triberg, Villingen, and Waldkirch.
III. Wood-carving.—Furtwangen, Bernau, and St. Blasien.
IV. Tobacco, cigar, and cigarette making.—Durlach, Bruchsal, Heidelberg, &c.
V. Cardboard box making carried on in Lahr.
VI. Silk weaving (ribbons).—Saeckingen, Wallshut, and Schönau.
VII. Wool and stuffs.—Above districts, and also Schopfheim.
VIII. Pottery.—Villingen, Hornberg, &c.

Schools for teaching wr[illegible]at at Furtwangen; for wood carving at Furtwangen ar[illegible] for straw-plait work at Furtwangen and at a large[illegible]s in the country districts. Permanent local exhibit[illegible]anches of the Trade Hall of Carlsruhe, exist in seve[illegible]ns, as at Triberg and Furt-

Schools in the Black Forest.

Exhibitions.

wangen, and an Art and Trade Exhibition of the industries of the Black Forest was held this year at Vöhrenbach.

Clockmaking school at Furtwangen.

We visited the clockmaking school at Furtwangen, and in the absence of the teacher we were received by Herr Koch, the principal of the wood-carving school held in the same building at the Gewerbe Halle. This school was founded with a Government grant in 1850. By means of lotteries and further grants, the Gewerbe Halle was erected and opened in 1874, and the school was transferred to the new building, and was re-constituted and formally opened in June 1877. The Government grant for this purpose was 650*l.* The school is managed by a local council chosen from the surrounding districts, and consisting of eight persons. The annual budget is 360*l.*, of which sum the province of Freiburg contributes 25*l.*, and Villingen 50*l.* The school is held in two small rooms, very ill-suited for the purpose, and a new building is in course of erection by the local Gewerbe Verein (trade society) at a cost of from 1,250*l.* to 1,500*l.* There are at present 18 pupils. Most of them are admitted free, and many are supported by exhibitions which are given by the neighbouring towns, and may amount to 20*l.* per annum. The school fee is 1*l.* per annum. The students must have been previously engaged for at least two years in practical clockmaking before they can be admitted. The course lasts one year. In the morning they have theoretical studies, consisting of geometry, arithmetic, algebra, physics, mechanics, technology of watch and clock making, geometrical drawing, projection, technical drawing, book-keeping, and commercial arithmetic, together with 30 hours practical work per week in the shops in the afternoon. The lathes and tools seemed excellent of their kind, but the accommodation was very cramped.

Clockmaking.

By far the most important manufacture of the Black Forest is that of small carved clocks, many of them with musical accompaniments, known as cuckoo-clocks. In Triberg, and a group of small towns and villages surrounding it, known as the clock country, 13,500 people, the population of upwards of 90 parishes, are engaged in clockmaking. We went to Schonach, a village in the hills above Triberg, where almost every cottage is the home of a clockmaker. The houses are large and substantially built. They are generally a considerable distance apart, and are surrounded with meadow-land and pastures. In addition to the home workers there are three or four small factories in which the wheels and other parts of clocks (Uhrenbestandtheile) are made. In one of these, visited by us, there were about five or six workmen employed, and an apprentice. The power was derived from a small overshot wheel. There was a wire-cutting and straightening machine for preparing the pinions, a lathe for shouldering and tapering the pinions, some fine drills, a tooth-cutting machine, and a shaping machine for the wheel teeth, a small press for driving on the bosses, &c. The machinery was ingenious, and well adapted for its purpose. The rough castings, made in the village, were excellent. We were told that the men working piece-work in the factories could earn from two to three marks* per diem, though a very small proportion of the workmen earn the latter sum. In a second factory we visited subsequently, the movements made here were being fitted together and made into clocks. Carpenters were making the rough framework to contain the wheels, and others were preparing the varnished outer cases. The clock passed from hand to hand, one man adding the winding barrel, another the train of wheels, a third the escapement, and another placing the works into the case. The clocks were being packed up for sale in another part of the works. They seemed all pretty much of one pattern, and of a very common description. The proprietor informed us that he produced clocks of exactly the same kind as those that were made in the cottages. They went mainly to various parts of Europe. None now go to England or to America. The Americans not only supply themselves with cheap clocks, but they have driven out the Black Forest maker from the English markets. The people employed at clockmaking live, we were told, very poorly, mainly on potatoes, though we saw soup and meat in some of the cottages. The cottages are very large; some of them

Visit to a factory.

Export of clocks.

Cottages.

* Marks = shillings nearly.

contain as many as 12 families. Many people have only one or two rooms and a bit of land, probably about 20 perches, for which theypay from 10 to 14 marks rent per month. An old gentleman, mowing in a very wet meadow, was pointed out to us as the Bürgermeister of Schonach. We went into several of the cottages and saw the people at their work. The women were polishing the clock cases and the men were making the wheel-work. We were told here that an industrious worker at home could earn as much as a good workman in a factory. The water power is everywhere most ingeniously utilised, and the water itself, is, as in many parts of England, employed for irrigation on the steep hillsides. Water power.

Schonach is the seat of a considerable industry in straw plaiting. Nearly all the women we met were plaiting. The straw used is rye-straw, grown in the place. It is sorted according to its thickness into some eight qualities. Whole straw is used for all except the finest work. For this latter, split straw is used. There are several large dealers in plait who supply the peasant women with straw and purchase the finished plait. These dealers have pattern cards with as many as 250 varieties of plait. The plait is sewn together by the dealers into hats and bonnets, and made into baskets. Straw plaiting.

We visited the manufactory of Messrs. Kienzler and Sauter, and there we saw some 30 different kinds of baskets, made in the neighbourhood. Here women were engaged in sewing the plait into hats with sewing machines (by Wilcox and Gibbs). The hats are subsequently shaped in presses. We were shown in the warehouse a large variety of plain and dyed straw hats. The baskets are made on blocks, in the cottages of the peasants. The block is given out with a sufficient quantity of plait, and a price is fixed for making each basket. The selling price ranges from 40 pfennings* to 2 marks 80 pfennings. Some of the baskets were nicely lined, and mounted with leather. In making the basket the upright straws, or warp, are nailed to the block, and the weft is then wound or woven in and out in one length from end to end. This is essentially a cottage industry, and could not well be done by machinery, as the shapes are constantly varying. The firm employ 300 hands, working in the surrounding villages. Straw plaiting is taught to all the children in the village school† by the mistress, who is an expert plaiter. They can often plait at three years old. The pay for the work is very small. A skilful workwoman only earns about four marks per week. Works of Messrs. Kienzler and Sauter. Straw baskets.

In various places in the Black Forest plaiting is taught in special schools; thus, at Furtwangen, there is a school held all the year round. These schools have been established by the Government to promote the introduction of this industry into districts where it appeared likely to succeed. The ages of the children under instruction range from 4 to 14. The instruction is given for three hours in the morning and for three hours in the afternoon. Some children attend the Volksschule in the morning and learn plaiting in the afternoon; others come to the straw-plait school in the morning, and attend the ordinary school in the afternoon. There are about 60 pupils. The name of the teacher is Fraulein Hippach. Most of the village straw-plait schools are winter schools only. Straw-plait schools.

Herr Doffner, an extensive dealer in straw plait, promised to prepare for us a complete set of samples of all the varieties of plait. His brother is a dyer, who produces the tints of fancy straw work. We were informed that only the plainer kinds of plaiting are done in the Forest. The fancy plaits, trimmings, &c. come from Switzerland and Italy. The women have a measuring board on which to ascertain the length of the piece. This board is about 30 inches long, and the plait has to go 20 times round it to make up a "piece," the payment for which varies from 15 to 70 pfennings for labour only. The length of the piece is said to be 32 metres. In the Gewerbe Halle of Furtwangen is an interesting collection of straw work done in the local school. The instruction seems to be all in the direction of simple straight plaits, though in elaborate patterns; and straw flower work, trimmings, and straw mosaic work does not Herr Doffner's samples. Straw mosaic work.

* 100 pfennings = 1 mark = 1 shilling.
† Special State aid is given to instruction in straw-plaiting in certain village schools.

appear to be taught. In the Gewerbe Halle of Triberg we saw, however, some good straw mosaic work, somewhat like Tunbridge ware. This was shown by E. Kem, who is the only straw dealer in Triberg. At Schramberg, on the eastern border of the Forest, in Wurtemberg, round which there is also a great deal of straw plaiting, are two large straw-hat manufactories, one of which, that of Messrs. J. P. Haas & Co., we visited. This factory employs 120 hands in the manufacture of straw hats and baskets, and covers a large extent of ground. In a court-yard we found a vast number of palm leaves, brought from Cuba, spread out to bleach in the sun. Many finished hats were also laid out for this purpose. The leaves are split up into thin strips, and used for making a special kind of woven hat made in one piece, by which means the use of the needle is avoided. The making of these hats is evidently an important branch of the trade. Herr Haas, the principal, informed us that little trade was done with England, except in Panama hats, made here from imported grass. The English straw plait is so much better than theirs, that they cannot compete. The Swiss and local straw, being inferior in colour, is mostly used for dyed hats. The firm import largely "Canton plait" from China, which is both better and cheaper than that made in the district. They also make a great many willow hats (mainly for infants and children). These are made from split shavings of willow, woven together into large square pieces by the peasants of Bohemia (this being a home industry). The material appeared to be in pieces about a yard square. In Herr Haass show rooms we saw an immense collection of hats, both trimmed and untrimmed. The firm keep a large stock of unshaped hats, the shape being given at the last stage of the manufacture, and, as this depends mainly on fashion, the hats are not blocked until Messrs. Haas learn the wishes of the foreign merchants.

Straw-hat factories at Schramberg.

Panama hats.

Willow hats.

Another important industry of the Black Forest is wood carving, and this, strange as it may seem, is now passing into the hands of the owners of the factories, or large workshops, where from 20 to 30 men are employed. The wooden clock cases are most of them finished with a carved oak or walnut front, and coarse carving of this kind is manufactured in Hornberg and the neighbourhood. We visited the factory of the Brothers Lehnis. Here the fronts of clocks were being carved wholesale, chiefly in walnut or in lime-tree wood. Much of the carving was very second rate. Messrs. Lehnis employ 34 workmen. The pattern was pounced through on to a board of the requisite size. The outline was then sawn out by means of a band-saw, and the relief, &c. form was given by the workman. The machinery was driven by water power.

Wood carving.

Factory of Messrs. Lehnis.

There is a school for teaching wood carving in the village; the school meets on two evenings and on Sundays. There are eight hours of practical work and two hours of drawing and modelling. There are at present 10 students (apprentices). This school is affiliated to the Art-Trade-School of Carlsruhe.

Wood carving school.

The most important wood carving school in the duchy is, however, at Furtwangen. This school is held on the upper floor of the Gewerbe-Halle. The teachers are Herr Koch and Herr Eberhard, by whom we were received and conducted through the rooms. There are at present about 30 pupils. They learn drawing, modelling, and wood carving. The lads who enter the school have no previous practical knowledge of the work, and are often mere peasant lads. There is no entrance examination. A regular prescribed course of work has to be pursued. They draw and model the different copies in clay, as well as carve them in wood. All the students learn drawing, and are competent to make thorough working drawings of anything they may have to carve. The work they execute belongs to them on paying for the wood. All the tools are supplied by the school. The local authorities find the premises, and the State pays the teachers and provides models and examples, as also the plant. The students all attend the classes of the Trade School* for technical and literary instruction, and one day in each week they are sent to the joiners' school to learn plain cabinet work and the construction of furniture. The students were

School for carving at Furtwangen.

Trade school.

* There are 44 trade schools in the Duchy of Baden.

most of them standing at their work. Some very excellent carving was being executed. The teacher of modelling and drawing, Herr Eberhard, had a private studio, and showed us a large collection of working drawings and details for various works executed from his designs, as album covers, clock cases, key-boards, frames, &c. in wood, and also objects in brass, iron, pottery, and enamels. The fact that the teachers are practically engaged in supplying designs for the local industries seems to have an important bearing upon the work of the school.

Carving for clock cases.

A large amount of wood carving is required annually in connection with the wooden-faced clocks made in the Forest, and, in addition to the work done in the small factories we have described, much carving is done by the workpeople in their own homes.

Tobacco manufacture.

Though we were informed that the manufacture of tobacco is carried on extensively as a home industry in the north-western districts of the Forest, we did not think that we were warranted in paying any attention to this industry, as the growth of tobacco is prohibited in the United Kingdom. Coarse tobacco is largely grown in Southern Germany, and doubtless the preparation of cigars and cigarettes from home-grown tobacco affords employment, at a very low rate of payment, to a number of young people and children.

Cardboard box-making at Lahr.

We visited Lahr, a small town north of Freiburg, to inquire into the flourishing home industry which has been established there for nearly 100 years, namely, the production of small cardboard boxes for chemists, confectioners, &c. This trade is in the hands of some seven or eight manufacturers. We visited the works of Herr C. F. Dreyspring, one of the largest in Lahr. He employs about 80 hands in the factory, mostly girls about 18 or 20 years of age. There are punching machines for making the tops and bottoms of the boxes, and cutting knives for preparing the narrow strips to form the sides of the boxes. Pill boxes and tooth-powder boxes seem to form the staple trade; but fancy silk and velvet covered boxes for bonbons, valued at as much as 8*s.* each, are also made here. The home production is mostly of the cheapest and simplest kinds of boxes; the better qualities are made in the works. The work is evidently mainly piecework; the girls work together in threes. The boxes are made of coarse cardboard and covered with various fancy papers. For some customers the boxes are labelled ready for use, and this used to be done for English houses, but it is said to be now prohibited by the Customs.* The pocket cases for court-plaister are also made in large numbers, solely for export to England. Only small boxes are made here, as it would not pay them to produce the large bulky boxes for haberdashers. There is a special department in the works at which the materials are prepared for giving out to the workers employed in their own homes. We were told that the children can begin work in the cottages at a very early age. This trade is confined to Lahr itself, scarcely anything being done in the surrounding villages. As the work requires great skill and manual dexterity, it is said not to be of a kind suitable for persons engaged in farming operations during a portion of their time. We were informed that, notwithstanding attempts to transplant the industry to other districts, it has never been successful elsewhere. There are about 2,000 persons wholly or partially employed in box-making, the number of factory hands amounting in busy times to between 700 and 800. Workers in factories earn more than persons employed at home. All the machinists were men; most of the box makers were females.

Factory of Herr Dreyspring

Trade not carried on by agricultural labourers.

Weaving in the Black Forest.

The weavers of the Black Forest are found chiefly in the villages in the extreme south. They devote themselves principally to the production of silk-figured ribbons and cotton stuffs. The industry is not in any way aided by schools or Government subventions, and did not appear to us sufficiently important to require special examination.

Pottery making.

The only product of the district we have still to mention is that of pottery, which is produced in small quantities in certain districts where the works might almost rank as home industries. The Government Art School at Carlsruhe has done much to provide better models for the

* This can only be true if the names were used to deceive purchasers as to the contents of the boxes being made by British firms. They were probably ordered by German houses, with English names, and contained German goods.

Pottery works of Herr Glatz.

potters, and we were recommended by the officials at Carlsruhe to visit the works of Herr Glatz at Villingen. These works are on a very small scale; the lower floor of Herr Glatz's house containing the throwers and pressers, and serving for the preparation of the clay, while the oven, the painting shop, modelling shop, and warehouse are contained in a small shed adjoining. The ware is a species of majolica, with outlined patterns in sgraffito, filled in with variously coloured slips and finished with a rich lead glaze. The decorative work is done on the dried clay previous to biscuiting. After being fired once with coloured slips, the ware is painted over with, or dipped in, a reddish glaze, producing when fired an agreeable fluxing of the tints. Many of the objects were designed by the students of the Art School at Carlsruhe. The Minister of Trade, we were told, takes much interest in this factory, and has sent specimens and models for imitation. These works were started in 1876, and employ only seven or eight hands. At Hornberg* we saw a small cottage factory, where some excellent stoneware was being produced.

Exhibitions.

We visited the permanent exhibitions at Furtwangen and Triberg. These are contained in buildings erected by the local trade societies, which are affiliated to the trade society† of Carlsruhe. The exhibition at Furtwangen, in addition to an excellent display of local manufactures, contains an historical collection of musical and other clocks, and many objects collected by the Government to serve as models or examples for local industries. There is also a good reading-room, with most of the principal trade and technical journals, and a library.

At Vöhrenbach the district exhibition of Black Forest industries is held in the rifle club buildings just outside the town. It is assisted by the Government, who have sent down a case of specimens from the Gewerbe Museum at Carlsruhe. The local trade society has promoted the exhibition, and has fitted up a suite of three rooms with furniture made in the district, which will serve as the chief prizes in a small lottery connected with the exhibition. The exhibition is nicely arranged, and contains an interesting set of specimens of all the different industries practised in the district. The collections of wood carving were very good. The clocks were better in design than those shown at Triberg and elsewhere, and showed the influence of the Carlsruhe school. This exhibition seemed in every respect an excellent example of what may be done by a small manufacturing community, remote from railways and large towns. It must be 15 miles to the nearest railway station, and 40 miles to any town of importance.

Nuremberg Exhibition.

Bavarian schools at the Nuremberg exhibition.

After seeing the industries of the Black Forest in the country itself, we went to Nuremberg, and spent several days in carefully examining the Bavarian Exhibition of Art and Industry, more especially those portions of it bearing upon our inquiry.

In this exhibition the work done in the various trade and industrial schools has received special attention, and an annexe or pavilion has been erected for a collective display of the school work of the country. Not only has the great Technical High School of Munich most carefully illustrated all branches of its teaching, both in the form of results of school work and in the appliances for teaching, but it sends also copious samples of its teaching apparatus, collections of artistic and scientific specimens, testing-machinery, &c. The remote village industrial schools, as, for instance, that for wood carving at Berchtesgaden, and the pottery school at Landshut, have also sent specimens of the works they have executed, together with printed or written statements of their progress, &c.

School work at Nuremberg.

Confining our attention to those schools destined to assist small local industries, we may class them under the following heads:—

1. Weaving schools.—Lambrecht, Passau, Münchberg, &c.
2. Wood-carving schools.—Garmisch, Spessart, Berchtesgaden, Bischoffsheim.
3. Basket-making schools.—Schaidt and Winzer.
4. Pottery school at Landshut.
5. Violin-making school at Mittenwald.

* We visited here the important potteries of Messrs. * * * *, who employ 800 hands.

† The German *Gewerbe Verein* is an association, both of employers and employed, to maintain the interests of the trade in the town or district, and to encourage thrift and intellectual progress.

Weaving Schools.—The display of fabrics, pattern books, and teaching apparatus, from the various Bavarian weaving schools, contained no essential points of difference from the objects shown us in similar and more important schools in other parts of the Continent. The woven fabrics from the school at Lambrecht (all said to have been produced in the school) were very numerous, and included some specimens of carpets, coatings, and woollen fabrics. The specimens from Passau and Münchberg, the latter school founded in 1863, included more cotton and linen fabrics. The class books showed that the teaching at all these schools is theoretical as well as practical. We were informed that weaving is a home industry in many parts of Bavaria, and these schools are doubtless intended to train up skilled workers and designers, and to improve the general character of the trade. Weaving schools. Weaving is carried on as a home industry

Wood Carving Schools.—The display of work in this section is exceedingly good. One of the best schools appears to be that of Garmisch near Partenkirchen. The course would seem to extend over three years. There were some good drawings and models in plaster by pupils, in addition to the practical work. A large number of students' drawing books were shown, as also a collection of photographs of carved work done in the school. Among the objects exhibited was a handsome cradle, valued at 20*l.*, and some well designed small full-length figures, carved in oak (probably for church decoration). A notice attached to the display stated that the school authorities were prepared to undertake work for the trade. The work was evidently thoroughly practical. Some good enriched mouldings were shown, which were undoubtedly intended for the cabinet-maker. Wood carving schools. At Garmisch.

The school at Bischoffsheim made a good show. This school was founded at Poppenhausen in 1854, and transferred to Bischoffsheim in 1861. The aim of the school is declared to be as follows :—"The introduction of wood "carving as a house industry into a number of dwellings in the Ronethal, "and the reward of meritorious work." The average number of scholars in each year during the past ten years has been 10. The school receives 85*l.* a year from the "Kreisfonds." Some spirited carvings of animals were shown, and the display was contained in an elaborate carved wood frame. Carving school at Bischoffsheim

Good collections of local work are shown from the carving schools of Berchtesgaden in the Salzkammergut, which has 106 pupils, and from the Spessart school of Lohr-a-Maine. From the latter the bulk of the work is of a very rude description, consisting mainly of all kinds of wooden utensils, shovels, spoons, &c. School at Berchtesgaden.

We could only find the work of two *basket-making schools;* one of them, at Schaidt, in the Rhinepfalz, contributes a large collection of baskets of all kinds, both in plain and dyed wood; also willow furniture, as chairs, cradles, &c. Some of the baskets were novel in point of design. Many of them were leather-mounted and some were lined. There was also a good collection of osier rods of several varieties, cultivated for the use of the school. Peter Vogel, travelling instructor (Wanderlehrer), states that "he is willing to supply grafts of Salix Viminalis, Salix "Schwurbitziana, or Salix Amygdalina"; the last, he says, "is the best "for the basket maker." Similar exhibits are sent by the school at Winzer, near Osterhofen, in Bavaria; very complicated basket work, furniture, woven work in wood strips, as mats, &c.; willow wood frames, and caps made of the tinder fungus (Schwamm). Basket making.

The school for *violin-making* at Mittenwald is on a very humble scale. There are at present 12 pupils. The total number of pupils since the foundation of the school in 1858, has been 95. The school course extends over three years. A large collection of partly finished violins was shown; also templates, or paper patterns, for cutting out the different parts of the instrument. The Government grant is said to be 280 marks (14*l.*) and the school is nearly self-supporting. Violin-making.

The *pottery school* at Landshut sends some rude green-glazed pottery, little superior to that of the peasant potters and stove makers. A stove exhibited by the school bears a label describing it as the work of eigh pupils. The length of time they have each been at the school is stated, Pottery-school.

and varies from 1½ to 2 years, the ages of the pupils being given at from 15 to 17. The shapes of some of the vessels showed signs of improved models, though there seemed to be very little attempt made to introduce decoration or artistic modelling of ornament.

We had no opportunity of personally examining the work actually being done in these schools, as in the case of the schools in the Black Forest, but to judge from the specimens exhibited there must be great similarity in the modes of teaching and in the general character of the instruction.

THURINGIA.

Visit to Thuringia.

Before our return to England we spent a couple of days in the district of Thuringia, which contains more varied industries than the Black Forest, and where we found much to interest us. Round Lichtenfels to the extreme south of Thuringia a considerable amount of straw plaiting is carried on by the villagers. We did not, however, stop in this country, but aimed first for Sonneberg, the seat of the toy manufacture, for which this part of the Forest is famous. On our way to Sonneberg we passed through Neustadt, and had the opportunity of seeing in the warehouse of Herr Dehler a collection of the chief varieties of toys and dolls made in this village and in the surrounding neighbourhood. The manufacture of dolls is here almost entirely a home industry, or one carried on in small workshops attached to the cottages, in which several men arrange to work together for the sake of the greater rapidity of work, obtained by division of labour. Herr Dehler took us to see a cottage workshop, where a man and his wife were engaged in dressing and arranging dolls' hair. This is their sole occupation. The hair is made of long English wool, suitably dyed and prepared, and it was being arranged in the most artistic fashion with flowers, in a great many different styles, on a number of almost life-sized dolls. The workers inhabited two rooms on the upper floor of a cottage, for which we were told they would probably pay 3*s.* 6*d.* per week as rent. They might, if industrious, earn as much as 20 marks per week between them.* The cottage would contain four families. Most of the people in the neighbourhood make papier maché toys, squeaking animals, confectioners' bon-bon boxes, in the form of animals, birds, &c., and small mechanical dolls of a very cheap description. Herr Dehler is himself a doll maker, and employs a large number of people who work at home, but fetch all their materials from his factory. He stated that there were no schools for toy making, nor in fact any education bearing specially on the industry. In driving to Sonneberg we passed numerous small china factories, where toy-animals, miniature dolls' services, and tea sets, &c. are produced.

Doll making at Neustadt.

Cottage industries.

The people engaged in making toys of papier maché.

Sonneberg, the principal town in the toy country, is in a very flourishing condition, and is being rapidly extended; more than 25 per cent. of the houses have been built during the last few years. Here the toy makers seem in many cases to have become manufacturers, and to employ numerous hands in large shops. The making of dolls of all kinds seems the chief trade here, though in the warehouse of Messrs. C. and O. Dressel we were shown a vast collection of other toys of every description, all produced in the surrounding country. Here again were no special schools for training young people as doll or toy makers. The school intended to serve for this purpose had been diverted from its original object, and has been made into a Real Schule capable of granting certificates to serve one year only in the army, instead of three. The only school in Sonneberg in which we could learn that any specialized instruction is given to the workpeople is the Gewerbliche Fortbildungs Schule, in which the lads are taught drawing, modelling, and carving. We visited this school, and found that the master was giving private lessons to two lads in wood-carving, and to a class of seven or eight in modelling in clay and wax. The Fortbildung class is held daily from 6 to 8 in the morning. The work we saw being done was remarkably good, and the master told us that the boys are very fond of modelling, and possess a considerable amount of innate skill. The Duke of Saxe Meiningen took great interest in the town in former times, and presented the authorities with a collection of plaster casts from the antique. He also caused a room in the Rathhaus to be

Sonneberg the metropolis of the toy country.

Warehouse of Messrs. Dressel.

The school now converted into a Real Schule.

Fortbildungs Schule.

Local museum.

* About 8*s.* 6*d.* each per week, deducting the rent.

decorated after his own designs. We went to see the collection and found it in great disorder. It has been partially dispersed, and the hall was being used at the time of our visit by the wife of the burgomaster as an ironing-room!—the dresses and linen hanging all round the room.

Trade is very prosperous.

We were informed that the trade is in an extremely flourishing condition, and that the chief manufacturers can scarcely comply with the demand. Toys are made by the peasants in all the neighbouring villages, and many of the workpeople make only some one part of some particular kind of doll, the complete toy being put together by a toy maker in the town. We visited a number of the workers in their own homes, and were much pleased with the clean and comfortable state of the houses.

Hüttensteinach.

At Hüttensteinach, a village a few miles north of Sonneberg, we found the chief home industries to be the making and covering of slate pencils, and the painting and polishing of china and glass marbles.

Lauscha.

At Lauscha, and the villages beyond it as far as Neuhaus, the population is extensively engaged in glass-blowing. There is a large gasworks, from which the mains extend to a distance of four miles. The gas appears only to be used for the glass workers' blow-pipes and not for illuminating purposes. The people we saw were engaged in making pearl and coloured beads, glass buttons, ornaments for Christmas trees, glass eyes for dolls and stuffed animals, &c. Glass-blowing is here essentially a home industry, but we could not learn of any schools connected with this work, or of any special means of instruction provided for the young people. The village of Lauscha is very singular in appearance, the houses being crowded together along a narrow line of steep hilly streets. The trade was said to have been introduced into the district by two Bohemian workmen, named Müller and Eichhorn, nearly 200 years ago, and these seem still to be among the commonest of the names of the villagers.

Glass-blowing a home industry.

Trade was introduced by Bohemians.

If the neighbourhood through which we passed is fairly representative of the forest country of Thuringia, it is impossible to overrate the importance, in a material point of view, of these home industries. The cottages were pretty and well kept; most of the windows contained flowers, beautifully grown in pots, and many of the houses had gardens attached to them. The people were well dressed, and had the air of being well fed and contented. They are evidently a most industrious race, and their success may depend as much upon their natural disposition and temperament, as on the fact that they have been trained for generations in these various occupations. Still, whatever may be the cause of their success in home industries, we think it is impossible to doubt that the influence for good of such work is of vast importance. We found populous and thriving villages, filled with busy workers, in districts remote from railways, and where carriage and transport must be matters of extreme difficulty, and in parts of the country, moreover, where agricultural work would in many cases be wholly insufficient to provide support for more than a small proportion of the present population. It is in such cases as these that the provision of suitable employment for the masses of the people is so important, and the question of the mode in which such industries are introduced, and the way in which they are fostered, is surely one which deserves the most careful attention of the economist.

People were well off.

Value of home industry.

Austrian Schools.

Visit to the South Austrian Provinces.

On the occasion of our journey to the South Austrian Provinces, we had first to proceed to Villach, in Carinthia, in order to meet Dr. Exner, one of the Government inspectors of schools, who had promised to give us all the necessary information respecting them, and to furnish us with introductions to the various school directors.

Interview with Dr. Exner at Villach.

The school at Villach has been established for about four years, and is mainly for instruction in joiners' work and wood carving. The schools under the Austrian Government may be divided into two categories, namely, 1st, those in which a sound theoretical instruction is imparted, with a certain number of hours daily, in the workshop, for practical work. Of these schools there are as yet comparatively few; and 2nd, those where the greater part of the time is spent in the shops; and the theoretical work consists mainly of drawing. In schools of the latter kind arrangements are sometimes made for a certain amount of theoretical or literary

teaching in the evening and on Sunday, generally by the master of one of the primary schools. The school of Villach belongs to the latter category. At the time of our first visit, a number of boys, most of them fresh from the primary school, were being taught drawing, almost entirely from copies (chiefly outlines of ornament). Two or three lads, who intended to become carpenters, were making details of wood construction; a more advanced pupil was preparing a full-size drawing of a lady's work-table, from the design of the drawing master, Herr Kastner, which he was about to make in the shop. In an adjoining room 7 or 8 older boys were carving. These, we were informed, were students, who had passed through the school, and were employed as journeymen, at daily wages, to execute work, for which orders had been obtained by the school. Two younger boys were engaged in elementary work. The carving class is under the tuition of the head master, who was absent on account of illness at the time of our visit. The staff of masters consists of the Director, Herr K. Schellhorn, a drawing and modelling master, Herr Kastner, and a foreman instructor of joiners' work.

Visit to the school at Villach.

Carving class.

Joiners' shop.

On the ground-floor was a large joiners' shop, in which, at a second visit, we found several boys employed; some furniture of a rather ambitious character being in course of construction. The masters, who had but recently been appointed, concurred in describing the boys as dull and difficult to teach. Some of the carving was excellent, and the collection of finished work shown to us was of very good quality, and superior to the work of similar schools we had seen on former occasions.

Course of instruction.

The school has 31 pupils. The full course lasts four years for carvers, and three years for joiners. The instruction is quite gratuitous. All boys who have gone through the primary school are eligible for admission. The master of the drawing school told us, however, that several of the lads who had recently come to the school had to be dismissed, owing to their gross ignorance. The drawing master, who accompanied us through the school (and who had just received his *congé*), took a gloomy view of its work and prospects. He said the school had not been established long enough for its influence on the district to have become manifest. On being asked whether wood carving was at present practised to any extent in the town or in the surrounding district, he replied that it was not, but that during the summer months there were many visitors to the baths and a considerable quantity of carved work was imported from Salzburg and the Tyrol, and sold in Villach, and it was hoped that by the foundation of the school a native industry might be implanted.

School intended to found an industry.

Schools at Cortina d'Ampezzo.

School for wood inlaying.

Intarsia work.

We next visited the school of wood inlaying and intarsia work at Cortina d'Ampezzo, in the Tyrol. This beautifully situated mountain village is in the heart of the Dolomite country; it has two schools, the one for wood industry and the other for silver filigree-work. In the former school are 41 pupils, who were all engaged in the shops at the time of our visit. The drawing master informed us that he gives 8 hours instruction weekly at each school. There is a show-room containing the works of the boys, which meet with a ready sale to summer visitors. They consist of frames, boxes, ornaments, and trinkets, with inlayed designs in different woods. Also a special kind of metal intarsia work, like piqué work, thin bands of brass being driven into grooves prepared in hard wood to receive them, and the ornamental figures thus produced being subsequently rubbed to a smooth surface and polished. The value of goods sold is about 420*l.* yearly. Much of the work was highly artistic, and the school was engaged in the execution of some special orders for a lady of rank.

Course of instruction.

The hours of instruction are from 7 to 11 and from 1 to 6 in summer,
and from 8 ,, 11 ,, ,, 1 ,, 4 ,, winter.

The course lasts four years. No boys can be received before the age of 14 years, and until the completion of their course in elementary schools. At the expiry of 4 years expert pupils can be retained as journeymen for a year longer, receiving daily pay, in accordance with their skill, the amount ranging from 40 kr. to 1·20 fl. per diem. The average earnings of a good mechanic appears to be about 1·20 fl. per diem in the village. Although the pupils were found to be engaged in different kinds of work, all follow the same course of instruction. In the inlaying shop, table tops

and parts of furniture were being constructed. A certain proportion of those engaged here were journeyman; the numbers being 18 adults, and 23 boys learning the trade.

The pupils draw 2 hours daily, and spend 6 hours daily in the shops.

School buildings.

The school building is provided by the commune, and has been almost doubled in size since the school was founded. It consists of a large workshop and class room on the upper floor with a show room and the office of the director. On the ground floor are two more large shops, a store for wood and materials, and closets, &c. The director is Signor Guedina.

Filigree school at Cortina.

We then visited the filigree school, which is held in the same building as the primary school, occupying two rooms on the upper floor. The work includes the entire process of manufacture,—the drawing of the wire, twisting it, cutting out the small copper moulds for the leaves and flowers, and the execution of the metal work itself. The workers are of both sexes. The school has been established for eight years, and on enquiring what became of the pupils who had been educated here, we were informed that only seven had finished their education. The master, Signor G. Ghedina, assured us that it needed from eight to ten years to become an expert workman. There is only one other filigree-worker in Cortina. The master was almost the sole possessor of the traditional art, and he had founded the school as a private adventure, and carried it on as such for several years, until it was taken over by the Government. The master could not point to anyone who had set up in business as a worker on leaving the school. Asked if he could supply a teacher able to instruct a class in a school elsewhere, he replied that he could do so. Part of the process, namely, the soldering of the twisted wires by means of the blow pipe involved the use of a material which he informed us was his own trade secret, but which he taught to his pupils. This work requires great delicacy of handling, and much artistic taste; the objects made in Cortina were said to differ from those made in Northern Italy, chiefly in the excellence of the manner in which the soldering was executed.

School taken over by the Government.

The master informed us that since the school had been taken over, few changes and little that was novel in the matter of examples and appliances had been introduced. This school was an interesting example of the way in which the Government of Austria is willing to assist and develope local effort in the matter of workshop instruction. The school was evidently but a very trifling grade above what might be found elsewhere, as the workshop of a private individual. The master of the school was clearly working with a keen view to profit, and to the sale of the work done by the pupils, who come and work long hours (10 hours daily) for at least three years in order to learn the business. It may be interesting to indicate the stages of manufacture as we saw them in progress. A girl was engaged in drawing silver-wire on a rude hand-wheel, through graduated perforations in a metal plate; this wire is subsequently doubled and twisted in lengths of about 10 feet by a multiplying wheel. The wire employed is very fine, and when twisted double is smaller in diameter than a fine lace needle. In making the trinket the forms of the separate leaves or petals are cut out in thin sheet copper and the wire is then neatly coiled round the outline, and round and round until the whole shape is filled in; by means of gentle pressure the wire leaves, what may be termed, the mould, and it is then gently heated and coated with some flux; The solder, which is in a finely powdered state, is next applied, and is melted by means of the blow pipe. All the appliances in the workshop, from the drawing frame to the blowpipe lamp seemed to be of the most antiquated construction. The leaves are bound together with wire and in some cases again soldered. Some of the work is gilt, but the bulk of the jewelry was in plain silver filigree. The school contai[illegible]3 adults and 8 apprentices; eight of the workers were fema[illegible]r master besides the director is the drawing master

School on a commercial basis.

Process of manufacture.

of the other school who gives instruction here also in drawing, in which all the pupils participate. Of the 28 students who have been educated in the school, 21 were still there at the date of our visit.

School for wood working at Riva.

We next visited the school for wood working and inlaying at Riva, which is located on the ground floor and in the basement of the communal school. This school has only been established here for some five or six months, having been removed hither from Tione in October last. The opening of this school took place on the 2nd November, and most of the masters and some five or six pupils were transferred from the former school. This institution is of a far more pretentious character than any of those previously described, as it aims at giving a good general education, concurrently with the industrial training. The lads spend all the morning in the class rooms and only take up industrial work in the afternoon. The complete course will extend over three years, but there is a preparatory class for new comers, and at the time of our visit nearly all the lads were in this class. Instruction is given in Italian and German, History, Geography, Algebra, Geometry, Arithmetic, and Book-keeping. The boys all learn drawing and most of them modelling. The trades taught are carpenters' and joiners' work, turning, carving, and wood-inlaying. It is intended almost immediately to fit up shops for metal working, and for masons' work, as some excellent freestone exists in the neighbourhood, and a company has been formed to work it. This company has provided two lads with bursaries to enable them to study at the school and to acquire the requisite knowledge of masons' work; trusting that they may be of use to them when they leave the school. The master, Signor G. Tamanini, who was formerly an engineer, and founded the school at Tione, on his own initiative, spoke strongly against the system of the creation of simple workshops, without the necessary provision of theoretical instruction. He informed us that he was well acquainted with the results of both classes of schools, and that nothing that was really good and lasting could be accomplished by institutions of the above kind. He aimed at making his pupils thoroughly conversant with the nature and properties of the material with which they had to deal. They should learn all that could be said of the growth or formation, construction, and strength, and the history and various uses of the materials with which they had to work. They should be able to draw or model accurately whatever they have to make, in any position, and they should be well acquainted with the most recent mechanical appliances for dealing with, or preparing, the materials for their trade. He said that only some 7 or 8 of the 100 Fachschulen under the Austrian Government gave a thorough and systematic training, such as that at which he aimed. In this school every piece of wood carving executed by a pupil is first drawn and then modelled by him in clay. Some of the pupils remain in the school for five years. He has at present two assistant masters and three workmasters. Some of the work brought from the school at Tione seemed very good, but the work in course of execution here was all of the most elementary kind, as the students had only entered at the end of last year. There is a special room set apart for wood-inlaying, in charge of a master who was trained at Tione. There are at present only two pupils in this department. A large stock of native woods, giving 130 distinct shades, has been collected, and, except for special tints, some 20 or 30 in number, they will be able to employ the produce of the surrounding neighbourhood. As examples of the work done at Tione, the director showed us several drawings of large and complicated pieces of furniture, which had been produced by the students from his designs, and executed by them under his directions. In a school so recently established, we could not ask for traces of its influence in Riva, but Signor Tamanini assured us that at Tione they had trained cabinet makers who had obtained excellent positions in Vienna, and even in America. He stated that the object of the school was to provide a high class education for the workmen of that province, and to serve as a nursery for the training of men who might eventually aid in the promotion of new industries, notably in connection with the excellent building stone, for which every facility of carriage existed, but which was now neglected. It was also hoped that skilled workers in olive wood might

Course of instruction.

New departments to be added.

Results of school teaching of trades.

Wood inlaying.

Work done in former school at Tione.

be trained who would do for Riva, what had already been accomplished in Arco.

Visit to the school at Arco.

Our next visit was to the workshop school at Arco, which has frequently been referred to, as an instance in which a new and successful industry has been created entirely by the foundation of a Fachschule. We found ample confirmation of this fact on visiting the manufactory of Signor C. Emert, the former master of the school, who now employs 30 workpeople and possesses a flourishing trade in objects made in olive wood. It had been pointed out to the authorities that, while at Bergamo, and other places in Italy, this wood is manufactured into numerous useful articles, in the Southern Tyrol, where it abounds, it was considered almost worthless, and was consumed in large quantities for fuel. A small school was started some six or seven years ago with workshops for wood turning and wood inlaying; competent teachers were obtained, and a good stock of the objects produced from olive wood in other countries was collected. The manufacture was a very simple matter; certain of the lads soon became expert workers; orders for work done in the school flowed in apace, and the master found himself unable to produce fast enough. He, therefore, took the best of the boys trained in the school, got a few skilled men from other places, and commenced a small manufactory.

Factory at Arco.

He is now employing about 18 men in the works and nearly as many more in their own homes, and sending the olive wood of Arco all over the world—largely to America and even to Italy, which he has deprived to a great extent of the trade. He told us that a firm in Boston had given him an order for 1500 blocks of wood having on them the word "Jerusalem," doubtless in order to sell them as relics from the Holy Land. The work he was doing seemed excellent, the designs being many of them most artistic, and the trade is evidently a thriving one. The school consists of two large well-lighted shops on the upper floor, one for turners' work and the other for wood inlaid work—the rooms on the ground floor serving simply for storage. It was only removed to this building a few months ago. There seemed to be but a very small stock of finished work on hand, and there are only 18 pupils, 9 in each division. The pupils can earn wages for work done, and some begin after a few months to earn 2*d*. or 3*d*. daily. In the fourth year their earnings may amount to 10*d*. per diem. This school is practically one which has done its work, the olive wood industry, which it was established to promote, has become a flourishing trade, giving employment to all the skilled workers that can be found, and the business of the school, considered in the light of an agent for the introduction of a new manufacture, has vanished. It must be remembered that in founding schools in various districts the aims of the authorities are not always the same. Thus in the case of the weaving schools and the pottery schools in Bohemia the intention was, by the introduction of improved machinery and the provisions of better models and designs, to give new vigour and impetus to handicrafts which had existed in the country for many generations. This has been the consideration which has influenced the Government in the large majority of the schools of this character. Many of the schools began simply as drawing and modelling schools, in which the future workmen could obtain a superior artistic training such as could not be gained in the ordinary workshop. Subsequently workshops for practical manual work were added to them, and in course of time the original "drawing and modelling school" has developed into a so-called "Fachschule."

School buildings and object of the school.

Visit to school at Innsbruck.

The school at Innsbruck, which was the next town visited, is one which has passed through these phases. It is a Government Gewerbeschule, intended principally for the training of architectural workers of various grades, and of engineers, but workshops for joiners and carvers have been added to it. The school is conducted in a handsome modern building, specially erected for the purpose by the municipality, and has only been opened a few months. The director, Herr Deininger, explained the nature of the instruction, and the character and aims of the institution. In the different sections, four in number, there are, in all, nearly 200 students. The class-rooms for free-hand drawing, geometrical and [illegible] drawing and modelling are well adapted for the purpose. A

receive theoretical instruction in addition to the work in the shops. There is a small physical cabinet and a rudimentary school museum. The director explained that a feature of the instruction was that visits were made by the entire architectural class to ancient buildings, which were carefully measured by them, and that subsequently a complete series of drawings were prepared to scale. Some of these sets of drawings were seen. The master of the modelling school, Herr H. Fuss, had designed an excellent set of examples, 12 in number, suitable for modellers in wax, who are preparing themselves for metal work—and a similar graduated series of copies has been designed by the master of the carving shop. The work done in the carving shop was excellent, and the joiners' shop was well supplied with tools and all the necessary appliances. As this is a school in which the official programme, drawn up by the Minister, is carried out most fully, we annex a copy of the time table. The course extends over three years, except in the applied art section, in which the course is one of four years.

Architectural instruction.

Official programme fully carried out.

School at Salzburg.

The last of the schools which came under our notice was that of Salzburg, formerly a drawing and modelling school, but transformed since 1876 into a Government Gewerbe school, with workshops attached. In many respects this school resembles that at Innsbruck, though the premises are vastly inferior. It is carried on in a salt warehouse, which has been fitted up with internal partitions for its reception. In the absence of the director, Herr C. Sitte, we were received by the architectural master, Herr Berger, who gave us a brief account of the institution, and conducted us through the class-rooms. The building trades division is chiefly a winter school, as during the summer months the students are engaged in practical work. In fact, with the exception of a class for land surveying, which is held during the first month of the summer session, this department of the school was empty. In the first and second years' course a small number of pupils were engaged in mechanical drawing, and the joiners' shop contained about a dozen youths who were working at the bench. The master of the carving shop, Herr Kiebacher, who is also the instructor in modelling, showed us the work being done in his department, and a large number of photographs of articles made from his designs by the students. The peasantry in this neighbourhood are, many of them, skilful carvers, and the trade flourishes traditionally as a home industry. The fabrication of pottery which was formerly carried on in Salzburg has become a lost art, and it is intended shortly to establish a class for practical potters' work in the hopes of re-establishing the manufacture. For this purpose a room has been fitted up with a wheel and lathe, and two kilns have been erected. As yet, however, owing to a contemplated change of masters, little of a practical nature has been accomplished. The department for reproductive processes of all kinds, in connection with this school, is one of much interest and importance. The aim of this division is to teach all the various known processes for the reproduction of works of art, or for preparing illustrations and copies. For this purpose ateliers have been fitted up and supplied with all the necessary appliances for (1) photography, including the retouching of positive and negative proofs, (2) photolithography, (3) photozincography, (4) heliography, (5) galvanoplastics, with the allied processes, (6) photo-engraving "*Lichtdruck*." Lectures are given on the theory of these processes, and practical work is carried on under experienced teachers in the laboratories. Students who have made themselves thoroughly efficient can have situations found for them by the school authorities. Special arrangements are made for auditors, or those taking part in a portion only of the teaching. We found among the students a gentleman practically engaged as a lithographic printer in America, who had come over to familiarize himself with the most recent German methods of working, and another student was an Anglo-Indian. The total number of students in all the divisions amounted to 294 in the winter half year and 163 in the summer session. There are 12 regular teachers and 8 occasional teachers. 23 students are in receipt of bursaries from the State and the town.

Building Trades school.

Joiners' and Carvers' shop.

Peasantry are skilful carvers.

Pottery school.

Department for Art Reproductions.

Divisions of this section

Number of students.

Inspection and sale of work.

The intention of the Government in the establishment of these various schools has been already explained. In order to secure their efficiency,

periodical visits are paid to them by a staff of inspectors, five in number, who present reports to the Minister respecting the state of the schools, the quality of the instruction, and the changes which appear advisable. Furthermore, to provide for the sale of the school work a depôt or show-room has been opened in Vienna, and there is also a technological trade museum under the direction of Prof. Exner, in which examples are gathered of all the best work done in the schools, together with collections of tools and plant, raw products, and models for instruction. A technological school journal is published monthly, under the supervision of the central authority, and a library is in course of formation.

Training of teachers for trades.

With regard to the training of teachers for special trade teaching, we found that the almost invariable custom was to select, in the first instance, a mere artisan of skill and ability, to give the needful practical instruction. From among the best of the pupils taught by him it becomes possible in many cases to procure competent young men to give similar instruction in other schools of the same character, and thus a nucleus of a few schools can soon be made a nursery for a large staff of masters or instructors. The boys taught are certain to turn their attention to that pursuit which holds out the best inducement in the shape of pay, and by offering them better pay as teachers than they could hope to earn in the workshop, a large proportion of those trained in the school could be secured as instructors.

Austrian system of trade instruction is very complete.

The system of school workshops inaugurated by the Austrian Government is probably the most complete in Europe, and the results, so far, appear to be most encouraging. Of course, in a country where trade and manufactures already exist under flourishing circumstances, State aided instruction, of the nature we have described, is far less needed than in those countries where the occupations of the population are mainly agricultural, or where industry is in a backward or declining condition. For districts resembling certain of the Austrian provinces;—for instance, some of our English colonies, and even for parts of Ireland—it seems to us that much may be learnt from what has been accomplished in Austria.

(Signed) PHILIP MAGNUS.
WM. WOODALL.
GILBERT R. REDGRAVE,
Secretary.

May 1883.

PROGRAMME of the GEWERBE SCHOOL at INNSBRUCK.

1st Course (Preparatory).

Subjects of Instruction.	Winter Semester. Weekly Hours of Study. Division for Building Trades. Masons, Polishers, Draughtsmen for Builders, and Stucco-Workers.	Stonemasons.	Joiners.	Carpenters, Tinsmiths, and Makers of Ironwork for Buildings.	Division for Artistic Trades. Modellers and Ornamental Sculptors.	Decorators, Glass Painters, Lithographers, and Photographers.	Gilders and Metal Workers.	Special Division for Wood Working.
German language	2	2	2	2	2	2	2	2
Geography	3	3	3	3	3	3	3	3
Arithmetic	3	3	3	3	3	3	3	3
Geometry	3	3	3	3	3	3	3	3
Natural history	1	1	1	1	1	1	1	1
Geometrical drawing	8	8	8	8	8	8	8	6
Freehand drawing	8	8	8	8	8	8	8	6
Modelling	6	6	6	6	6	6	6	6
Workshops	—	—	—	—	—	—	—	18
Total number of hours weekly	34	34	34	34	34	34	34	48

Subjects of Instruction.	Summer Semester. Weekly Hours of Study. Division for Building Trades. Masons, Polishers, Draughtsmen for Builders, and Stucco-Workers.	Stonemasons.	Joiners.	Carpenters, Tinsmiths, and Makers of Ironwork for Buildings.	Division for Artistic Trades. Modellers and Ornamental Sculptors.	Decorators, Glass Painters, Lithographers, and Photographers.	Gilders and Metal Workers.	Special Division for Wood Working.
German language	2	2	2	2	2	2	2	2
Geography	3	3	3	3	3	3	3	3
Arithmetic	3	3	3	3	3	3	3	3
Geometry (projection)	3	3	3	3	3	3	3	3
Natural history	1	1	1	1	1	1	1	1
Geometrical drawing	8	8	8	8	8	8	8	6*
Freehand drawing	8	8	8	8	8	8	8	4*
Modelling	6	6	6	6	6	6	6	6
Workshops	—	—	—	—	—	—	—	24
Total number of hours weekly	34	34	34	34	34	34	34	52

* For carpenters and turners, geometrical drawing 6 hours, freehand drawing 4 hours.
For carvers and intarsia workers, geometrical drawing 4 hours freehand drawing 6 hours.

2nd Course.

Winter Semester.									Summer Semester.					Remarks.
Subjects of Instruction.	Weekly Hours of Study.								Subjects of Instruction.	Weekly Hours of Study.				
	Department for Building Trades.				Department for Artistic Trade.					Department for Artistic Trades.				
	Masons, Polishers, Draughtsmen for Builders.	Stonemasons.	Joiners.	Carpenters and Makers of Iron-work for Building.	Modellers and Ornamental Sculptors.	Decorators, Glass Painters, Lithographers, and Photographers.	Gilders and Metal Workers.	Special Division for Wood Working.		Modellers and Ornamental Sculptors.	Decorators, Glass Painters, Lithographers, and Photographers	Gilders and Metal Workers.	Special Division for Wood Working.	
Natural history	2	2	2	2	2	2	2	2	Natural history (laws of colour)	—	1	—	—	(1) Optional only for wood carvers in this division.
History of style	2	2	2	2	2	2	2	2	History of style	1	1	1	1	(2) Optional only as respects the lectures for carpenters and turners in this division.
Building construction	2	2	2	2	—	—	—	—	History of art	1	1	1	1	(3) For builders, artistic drawing, and drawing of styles.
Elements of anatomy (1)	—	—	—	—	2	2	2	2	Encyclopædia of technical arts	1	1	1	(5) 1	(4) For this division, only the chapter relating to wood working.
History of art	1	1	1	1	1	1	1	1	Technical drawing	6	8	12	6	(5) Drawing from the cast.
Trade book-keeping	2	2	2	2	2	2	2	2	Freehand drawing	9	(4) 4	9	4	
Theory of projection (2)	3	3	3	3	—	3	3	1	Decorative painting	—	12	—	—	
Applied drawing (3)	12	12	—	—	10	12	12	6	Wax modelling	4	—	4	—	
Freehand drawing	6	6	6	6	6	6	6	6	Modelling	10	4	6	4	
Modelling	4	4	4	4	9	4	4	4	Elements of anatomy	2	2	—	2	
Workshops	—	—	—	—	—	—	—	24	Workshops	—	—	—	33	
Total number of hours weekly	34	34	34	34	34	34	34	50	Total number of hours weekly	34	34	34	52	

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OF THE

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ON

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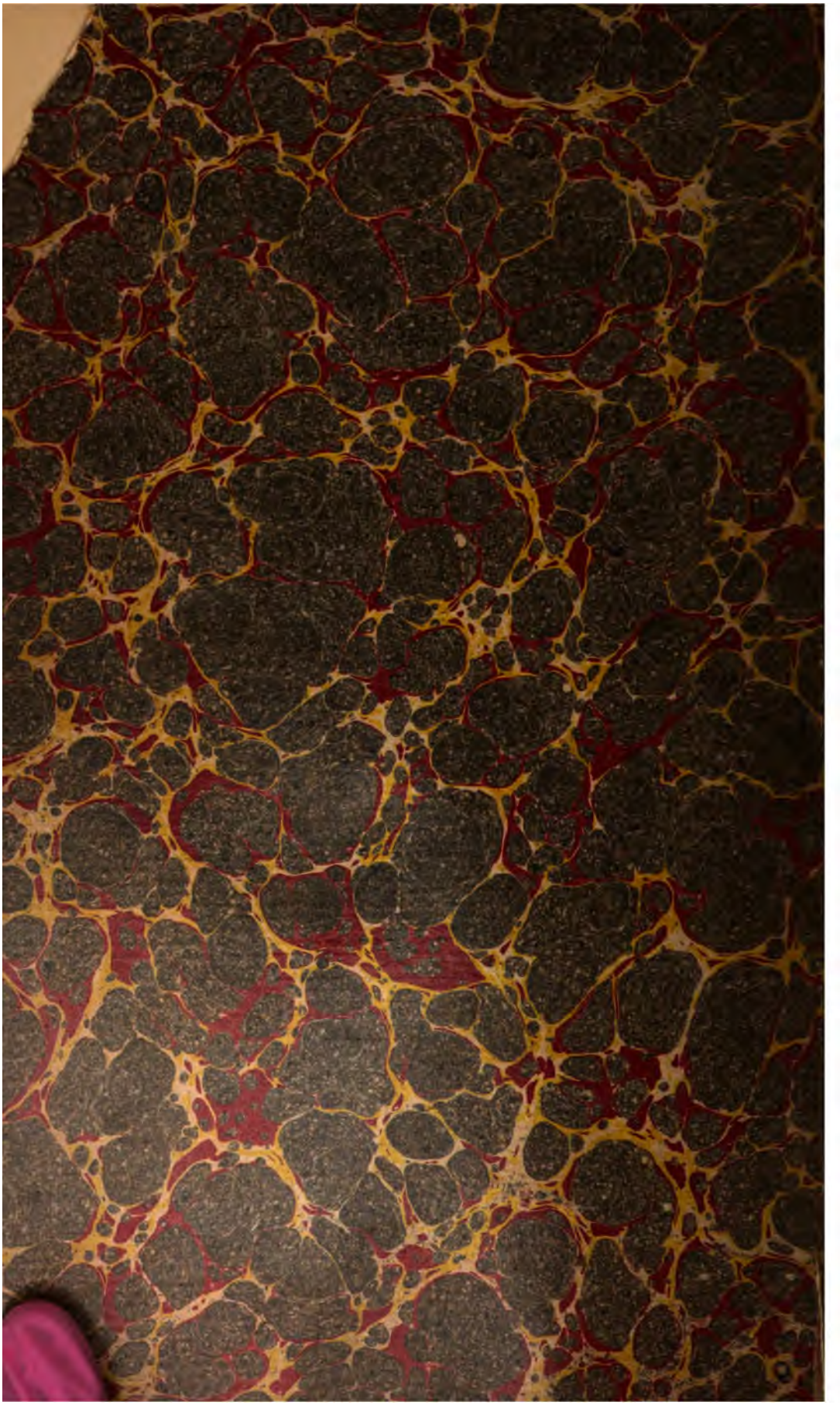

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